Chapter 3: The Refuge Environment and Management

Introduction

Sherburne National Wildlife Refuge lies on the edge of three important plant communities in Minnesota: the coniferous forests to the north, the broadleaf forests to the southeast and the prairies to the west.

USFWS

The Refuge's sandy, thin soils tell the story of the geological history of land that is known as the Anoka Sandplain. Ten thousand years ago, the area was formed as a sandy glacial lake bottom after the Wisconsin glacier started to melt and retreat. A small river, the St. Francis River, runs through the Refuge and drains into the Elk River, which ultimately enters the Mississippi River south of the Refuge boundary.

The land in the area of the Refuge was originally surveyed in 1855, prior to European settlement, by James Marsh who described a typical township as follows:

> "There are quite a number of lakes and ponds in this township, with some fen marshes and tamarack swamps. The surface is gently rolling, soil sandy and light and... second and third rate timber very poor scattering. Mostly a growth of black and bur oaks, aspens with tamarack in the swamps..there are no settlers in this township."

Geographic/Ecosystem Setting

The Fish and Wildlife Service Ecosystem

The Service has adopted an ecosystem approach to conservation and designated 53 ecosystem units. The ecosystem units delineate portions of the landscape where the Service and its partners can set ecosystem-wide resource goals and work together to achieve these goals.

The Refuge is located in the Mississippi Headwaters/Tallgrass Prairie Ecosystem. The extent and features of the ecosystem are described in Chapter 1 of this Draft CCP.

An ecosystem team has identified the following work activities in response to resource management challenges and opportunities:

- # Restore, enhance and conserve important habitats/communities.
- # Restore, enhance and conserve aquatic resources in the Mississippi Headwaters/Tallgrass Prairie Ecosystem.
- # Restore, enhance and conserve quality and rare resources (especially imperiled and native species) to increase or maintain biodiversity.
- # Create or improve partnerships to accomplish ecosystem goals.

Migratory Bird Conservation Initiatives

Over the last decade, bird conservation planning has evolved from a largely local, site based focus to a more regional, landscape oriented perspective. Significant challenges include locating areas of quality habitat for the conservation of particular guilds and priority bird species, making sure no species are inadvertently left out of the regional planning process, avoiding unnecessary duplication of effort, and identifying unique landscape and habitat elements of particular tracts targeted for conservation, management and restoration. Several migratory bird conservation initiatives have emerged to help guide the planning and implementation process. Collectively, they comprise a tremendous resource as Sherburne NWR engages in comprehensive conservation planning and its translation into effective on the ground management.

The North American Waterfowl Management Plan

Signed in 1986, the North American Waterfowl Management Plan (NAWMP) outlines a broad framework for waterfowl management strategies and conservation efforts in the United States, Canada, and Mexico. The goal of the NAWMP is to restore waterfowl populations to historic levels. The NAWMP is designed to reach its objectives through key joint venture areas, species joint ventures, and state implementation plans within these joint ventures.

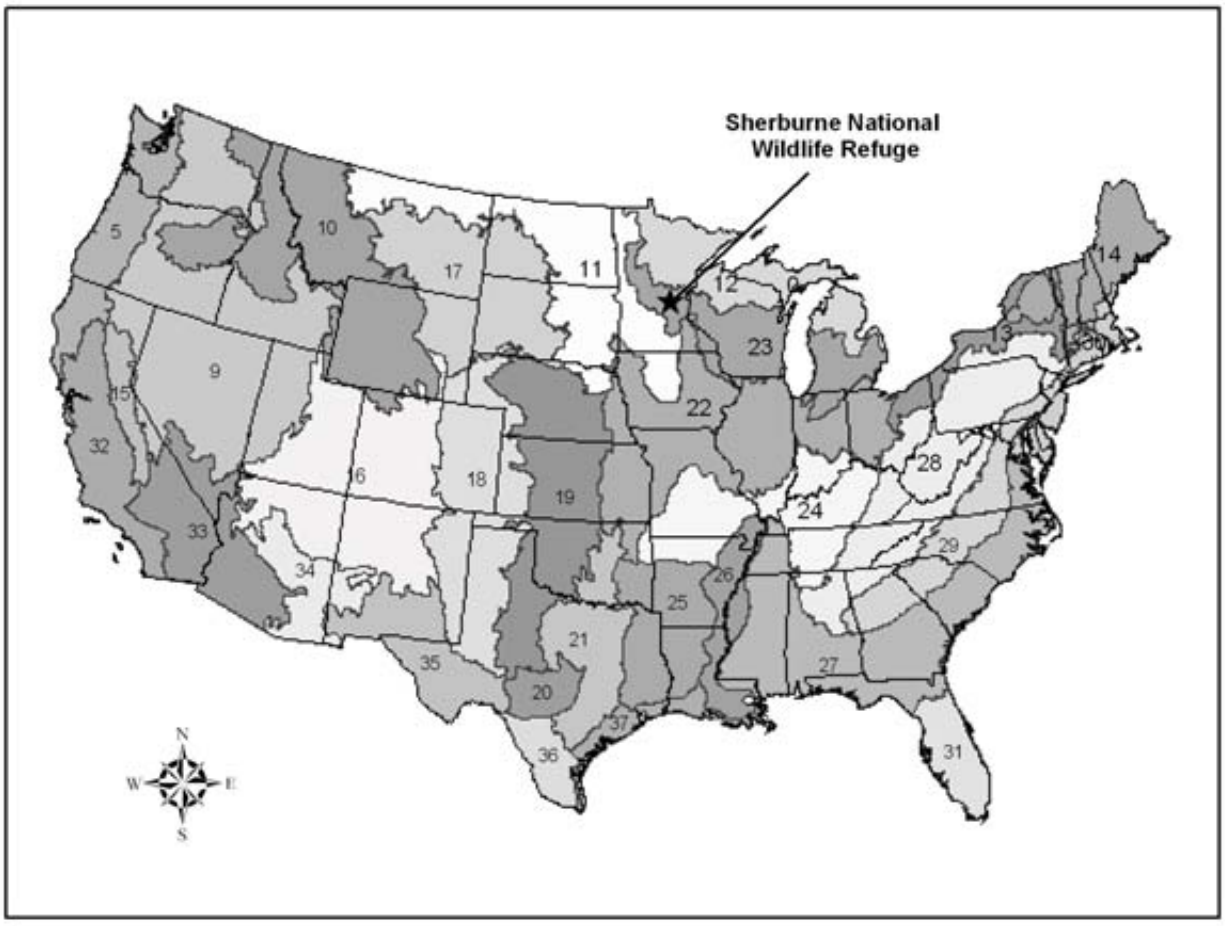
The Refuge is in the Upper Mississippi River Great Lakes Region Joint Venture. One of 12 habitat based joint ventures, this Joint Venture encompasses the states of Michigan and Wisconsin in their entirety, plus portions of Minnesota, Iowa, Nebraska, Kansas, Missouri, Illinois, Indiana and Ohio. The goal of this Joint Venture is to increase populations of waterfowl and other wetland wildlife by conserving, restoring and enhancing wetland and associated upland habitats within the Joint Venture region. The objectives of this Joint Venture are:

- # Conserve 9,118,884 acres of habitat capable of supporting an annual breeding duck population of 1,542,000, under average environmental conditions, by the year 2013.
- # Conserve 532,711 acres of habitat on migration focus areas capable of supporting 266 million duck use days during annual fall migration, under average environmental conditions, by the year 2013.
- # When consistent, contribute to the conservation and/or increase of habitats for wetland and associated upland wildlife species in the Joint Venture, with emphasis on declining migratory birds.

North American Bird Conservation Initiatives (NABCI)

Formed in 1990, Partners in Flight (PIF) is concerned with most land birds and other species requiring terrestrial habitats. Partners in Flight has developed Bird Conservation Plans for numerous Physiographic Areas across the U. S. These plans include priority species lists, associated habitats, and management strategies. Reflecting the local physiography, Sherburne NWR lies within PIF Physiographic Area 40 Physiographic Area.

Figure 5: Bird Conservation Planning Physiographic Areas



The U. S. Shorebird Conservation Plan and the North American Waterbird Conservation Plan are plans that address the concerns for shorebird and water birds. These larger scale plans identify priority species and conservation strategies.

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In a continental effort, the Partners in Flight, North American Waterfowl Management, U. S. Shorebird Conservation, and the North American Water Bird Conservation plans are being integrated under the umbrella of the North American Bird Conservation Initiative (NABCI). The goal of NABCI is to facilitate the delivery of the full spectrum of bird conservation through regionally based, biologically driven, landscape oriented partnerships. The NABCI strives to integrate the conservation objectives for all birds in order to optimize the effectiveness of management strategies. NABCI uses Bird Conservation Regions (BCRs) as its planning units. Bird Conservation Areas are becoming increasingly common as the unit of choice for regional bird conservation efforts; Sherburne NWR lies within BCR 23 (Figure 5.)

Each of the four bird conservation initiatives has a process for designating conservation priority species, modeled to a large extent on the PIF method of calculating scores based on independent assessments of global relative abundance, breeding and wintering distribution, vulnerability to threats, area importance (at a particular scale, e.g. BCR), and population trend. These scores are often used by agencies in developing lists of bird species of concern; e.g., the U. S. Fish and Wildlife

Service based its assessments for its 2002 list of nongame Birds of Conservation Concern primarily on the PIF, shorebird, and water bird status assessment scores.

Region 3 Fish and Wildlife Conservation Priorities

The Resource Conservation Priorities (RCP) list is a subset of all species that occur in the Region and was derived from an objective synthesis of information on their status. The list includes all federally listed threatened and endangered species and proposed and candidate species that occur in the Region; migratory bird species derived from Service wide and international conservation planning efforts; and rare and declining terrestrial and aquatic plants and animals that represent an abbreviation of the Endangered Species program's preliminary draft "Species of Concern" list for the Region. The RCP list also includes invasive species in need of conservation action (Appendix I). Although many species are not included in the priority list, this does not mean that we consider them unimportant.

The list includes 60 species or populations for the Service's Mississippi Headwaters/Tallgrass Prairie Ecosystem.

Other Conservation and Recreation Lands in the Area

The portion of the Refuge that extends south of County Road 4 is bounded by the Sand Dunes State Forest. This State Forest provides a patchy buffer (due to its 3,155 acres of private inholdings in addition to the 5,456 acres of State-owned land) of undeveloped land where it is adjacent to the Refuge. Its mission as a Minnesota State Forest is to produce timber and other forest crops, provide outdoor recreation, protect watersheds, and perpetuate rare and distinctive species of flora and fauna.

The Uncas Dunes Scientific and Natural Area lies within the Sand Dunes State Forest and contains a rare sand prairie and savanna remnant. Outside of this, over half of the state-owned land area of the Sand Dunes State Forest has been planted to conifers (predominantly Norway pine, white pine, Jack pine, white spruce and Norway spruce). Its vegetative cover differs greatly from that found on the Refuge, for the most part.

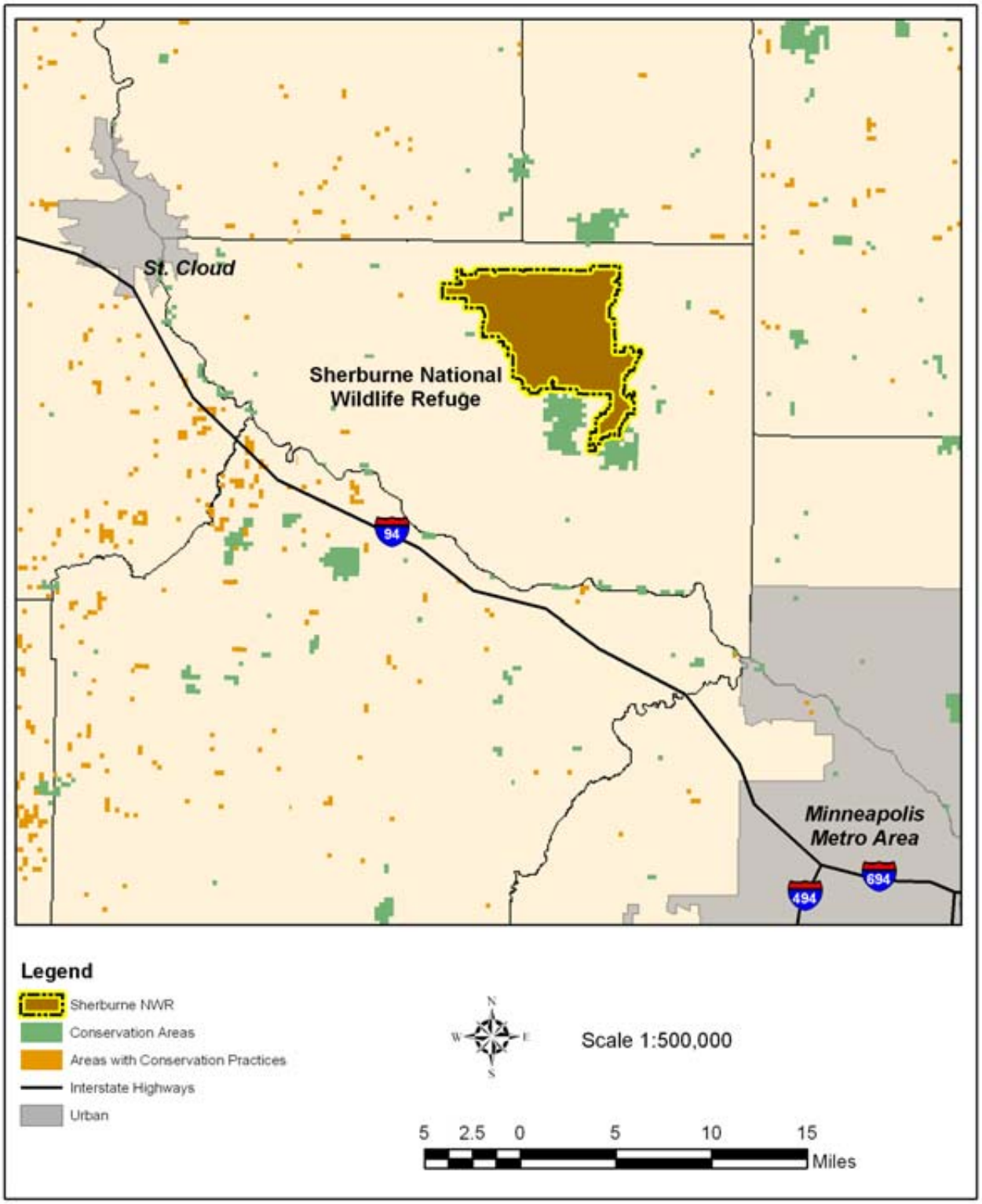
There are also seven state wildlife management areas (WMAs) managed for natural resources within a 5-mile radius of the Refuge (Figure 6). These areas are smaller parcels owned by the State for the purposes of wildlife management, including the provision of wildlife-related recreation and education. They are the Kunkel WMA (2,165 acres located 1 mile to the north), Benlacs WMA (571 acres located 4 miles north), Glendorado WMA (200 acres located about 3 miles north), Freemont WMA (182 acres located about 1 and one-quarter miles to the east), Santiago WMA (80 acres located less than 1 mile to the west), Vietnam Veteran's Memorial WMA (80 acres located about 4 miles to the east, across U.S. Highway 169), and the Bibles WMA (67 acres about 4.5 miles north).

Socioeconomic Setting

Population

Minnesota's population grew 9 percent from 1990 to 1998 according to the State Demographic Center at Minnesota Planning. The population is expected to increase 14 percent over the next 25 years with the most dramatic increase in the Brainerd lakes area and the counties around the Twin Cities. The City of St. Cloud and surrounding urban areas expect a 35 percent rise in population between 1998 and 2020.

Figure 6: Other Conservation Areas in the Proximity of Sherburne NWR



Sherburne County is in the heart of this suburban expansion. In the years from 1990 to 2000, the townships surrounding the Refuge (Becker, Orrock, Blue Hill and Santiago) saw population increases of 74 to 106 percent. Three cities within Sherburne County have more than doubled in population during this time (Sherburne County Zoning Office). Sherburne County has also been included in the newly expanded nine-county metropolitan area of the Twin Cities.

Sherburne County's population has increased greatly compared to Minnesota and the United States. The County's population has a higher percentage of high school graduates (90 percent) than both the State of Minnesota (88 percent) and the United States (80 percent). Sherburne County's home ownership rate (84 percent) is nearly 20 percent higher than the United States (66 percent) (Minnesota State Demographic Center).

The City of Zimmerman designated Urban Expansion Zone approaches within 1.25 miles of the Refuge boundary from the east. The City of Elk River's Urban Expansion District comes within 1.5 miles of the Refuge boundary to the southeast and the Urban Expansion Zone of the City of Princeton approaches within 2 miles from the northeast.

Urban development throughout the Anoka Sandplain is a major conservation concern. This includes lands surrounding the Refuge. Due to its location and easy access to the St. Cloud and the Twin Cities urban centers, residential and, to a lesser extent, light business development is occurring rapidly in the area around the Refuge.

Lands directly adjacent to the Refuge are developing into rural residential and residential subdivisions, especially on the Refuge's east, southeast and south sides. There are also some areas, especially to the north, west and northeast that remain in agricultural use. The majority of these areas are in production for corn and soybeans, or are used as pasture for cattle.

These land use patterns portray a trend of increasing development of lands adjacent to the Refuge. As more and more people move into the area, the demand for recreational opportunities has also grown.

Sherburne NWR represents the largest public land holding in the County.

Employment

In 1980, more than two-thirds of employment in Sherburne County was concentrated in four sectors: transportation and public utilities (14 percent), retail trade (17 percent), government (20 percent), and services (20 percent). In 2001, employment continued to be strong in government (13 percent), retail trade (16 percent), and services (33 percent). However, transportation and public utilities experienced a noticeable decline, with employment representing only 4 percent of total employment in Sherburne County. Furthermore, employment in transportation and public utilities was the only sector to suffer any decrease between 1980 and 2001. Dramatic employment increases were exhibited in the construction sector and manufacturing sector.

Employment in Sherburne County escalated between 1980 and 2001 (71 percent). While the Sherburne County population has grown considerably over the last 20 years, the rise in employment has outpaced population growth. The employment increase in Sherburne County is double the employment increase in the State of Minnesota (35 percent) over the same time period.

Income

In 2001, employment earnings in Sherburne County totaled $789 million, which was an 86 percent increase from earnings in 1980. This earnings growth is nearly double the statewide earnings growth rate in Minnesota.

Employment earnings in 1980 were concentrated in the government sector and in the transportation and public utilities sector, which together accounted for approximately 46 percent of the County's earnings. Between 1980 and 2001, employment earnings have become more evenly distributed across the major business sectors. In 2001, services represented 20 percent of County earnings, which was followed by government (19 percent), manufacturing (16 percent), construction (13 percent), and retail trade (11 percent). The contribution of transportation and public utilities toward County earnings diminished significantly, dropping from 24 percent to 4 percent. The finance, insurance, and real estate sector remained fairly stable, representing between 3 percent and 5 percent of the County's earnings from 1980 to 2001.

During the past two decades, per capita personal income (PCPI) in Sherburne County was consistently less than both Minnesota and the United States. Furthermore, Sherburne County's PCPI was only 85 percent, 80 percent, and 76 percent of Minnesota's PCPI in 1980, 1990, and 2001, respectively. This increasing margin is due to Minnesota's PCPI growth rate exceeding the U.S. growth rate, while Sherburne County's PCPI growth rate has not kept up with the United States.

Climate

The climate in east-central Minnesota is classified as 'sub-humid continental' and is characterized by significant variations between summer and winter temperatures. The region has four distinct seasons with moderate spring and fall weather. Summer is comfortable because lakes and trees serve as natural air conditioners. The winters in nearby Minneapolis, the second coldest city in the United States, have an average daily temperature of 35 degrees Fahrenheit.

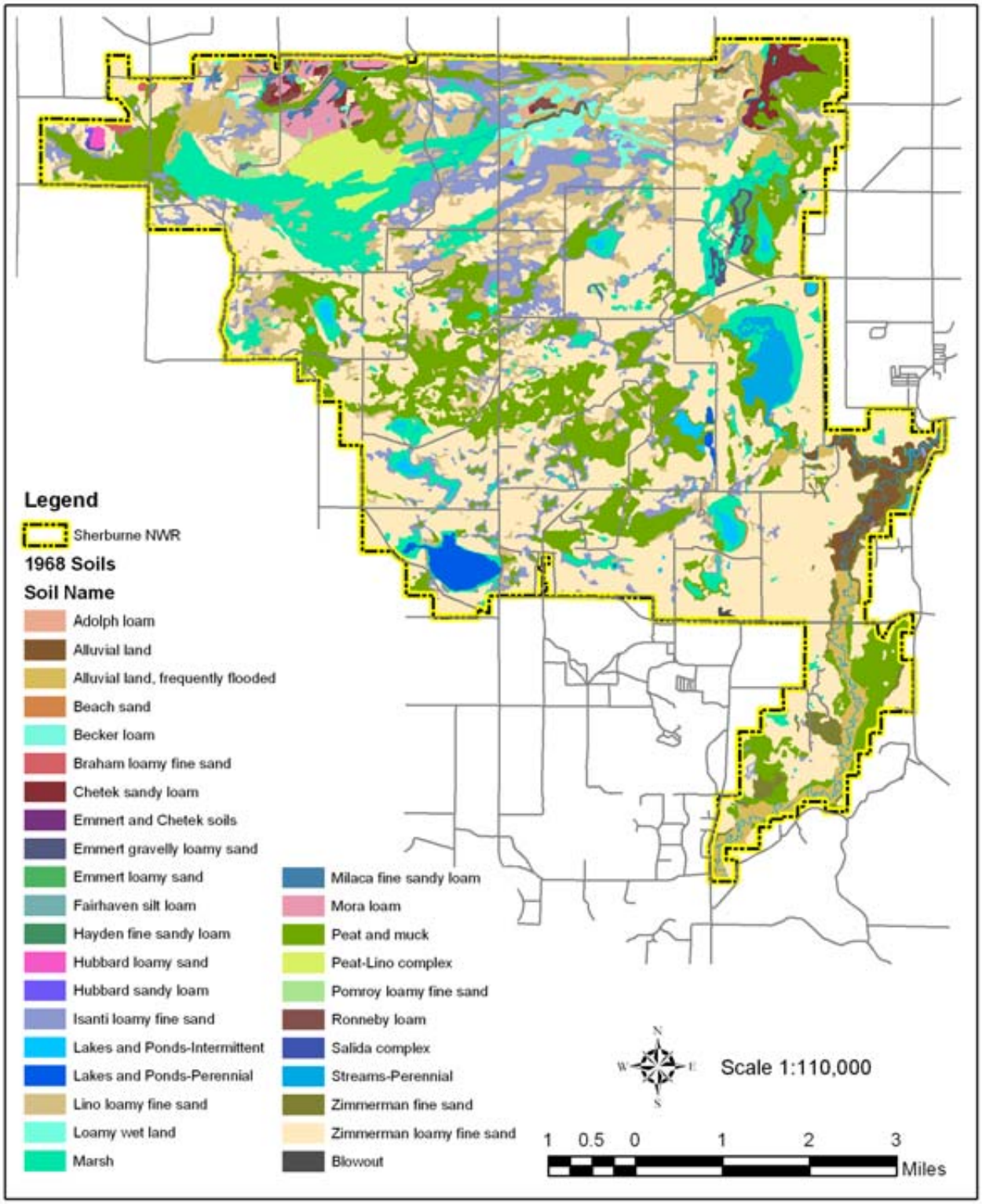
The mean temperature during December, January, and February is 13.3 degrees Fahrenheit. The temperature can drop to between minus 20 degrees and minus 30 degrees Fahrenheit on several days each winter. The June, July and August mean temperature is 68.2 degrees Fahrenheit. Frost is likely to occur until mid-May, and to return by the end of September. The latest recorded occurrence of a freezing temperature in spring is June 9, and the earliest in fall is September 3. The freeze-free period is long enough that such crops as corn, soybeans, small grain, and vegetables generally have time to reach maturity.

Precipitation is well distributed throughout the growing season. About 17.4 inches, or 60 percent of the total annual precipitation, falls during the period from May through September. The average annual precipitation ranges from around 26 to 31 inches. In 1976, a total of only 13.07 inches of precipitation was recorded at the DNR reporting station in nearby Zimmerman during the entire year. During the following 7 months, from January to July 31, 1977, 21.08 inches had fallen, thus indicating the substantial variation that can occur (USDA Climate Data).

Geology and Soils

The Refuge lies within the deciduous forest-woodland zone of Minnesota on the Anoka Sandplain, a large flat sandy outwash area now thought to be lacustrine in origin, with small dune features and low moraines exposed above the outwash (Wright, 1972). This zone in Minnesota is transitional between tallgrass prairie and deciduous forest. The uplands within the Refuge consist of these flat sandy areas with some rolling small sand dune areas, interspersed with wetlands and four natural lakes. Upland soils are Zimmerman, Lino and Isanti loamy fine sands from 0 to 6 percent slope, good drainage, very low water holding capacity, and high erosion potential, severe limitations for crops, but suitable for pasture or range (USDA, Soil Conservation Service, 1968) (Figure 7). These soils are placed in the Zimmerman-Lino-Isanti-peat Soil Association due to the presence of many small scattered peat bog inclusions. The presettlement vegetation on the uplands throughout the Anoka Sandplain was oak barrens and openings (MN-DNR, 1996b).

Figure 7: Soils, 1968, Sherburne NWR



The Mille Lacs Uplands subsection of the State's Ecological Classification System comes into the northern portion Refuge. Overall, this subsection covers the large area of Superior Lobe ground moraines and end moraine in east central Minnesota. The vegetation at pre-European settlement times consisted of a mosaic of forest types. Along the southern boundary, where it intersects the Refuge, maple-basswood forests were prevalent (MN -DNR, 1996b). Soils in the portion of this subsection which lies in the Refuge belong to the Milaca-Mora-Ronneby Soil Association. These nearly level to undulating soils overlay slightly acid, red, glacial till and range from the fine sandy loam Milaca soils to the somewhat poorly drained loam Ronneby soils. Uncleared areas support fair stands of mixed hardwoods (USDA, 1968). Soils in this association make up three percent of the Refuge's total area, while soils in the Zimmerman-Lino-Isanti-peat Association make up the other 97 percent of the Refuge lands (USDA, 1968). The distribution of the major soil associations on the Refuge is shown in Figure 7.

Water and Hydrology

The majority of the Refuge is located within the St. Francis River Watershed, which extends northward into Benton County (Figure 8). The Refuge was developed along a portion of the St. Francis River Valley, historically known for its wildlife resources. The St. Francis River begins in Benton County, about 18 miles from where it enters the northwest corner of the Refuge. After traveling through the Refuge, the St. Francis River exits the Refuge's south spur and drains into the Elk River just north of Big Lake, then drains into the Mississippi River within the city limits of Elk River. The middle one-third of the Refuge's western boundary follows the boundary of the Snake River Watershed, which lies to its west. A small portion of the Refuge lies within the Snake River Watershed, including Johnson Slough and Orrock Lake.

Refuge Resources

The predominant presettlement vegetation on the uplands throughout the Anoka Sandplain was oak barrens and openings (MN-DNR, 1993) (Figure 9). Fire suppression began with Euro-American settlement around 1850, dramatically changing vegetative communities that had developed under a fire regime dictated by weather and Native Americans.

Douglas Johnannsen

Once open oak barrens filled in to become Dry Oak Forest (Wovka et al. 1996). Often these were pastured. Though light soils presented severe limitations for crops (USDA, Soil Conservation Service, 1968) most settlers became farmers and put large areas under cultivation.

While the nation was reeling from the economic depression of the 1930s, the “dust bowl” years brought another burden to the farmers. The double blow of the Depression and drought was felt in the townships that make up the Refuge, as strongly as any place in the State. Farm abandonment became commonplace during the 1930s and early 1940s. It was from these tax-forfeited lands that the first public land came to exist in the area, as part of the Sand Dunes State Forest. This occurred in 1943, by an act of the State Legislature, in an attempt to stabilize soils. Conifers grew extremely well on the sandy soils and were planted by the millions in the then 2-square-mile State Forest. Private

Figure 8: Watersheds Surrounding Sherburne NWR

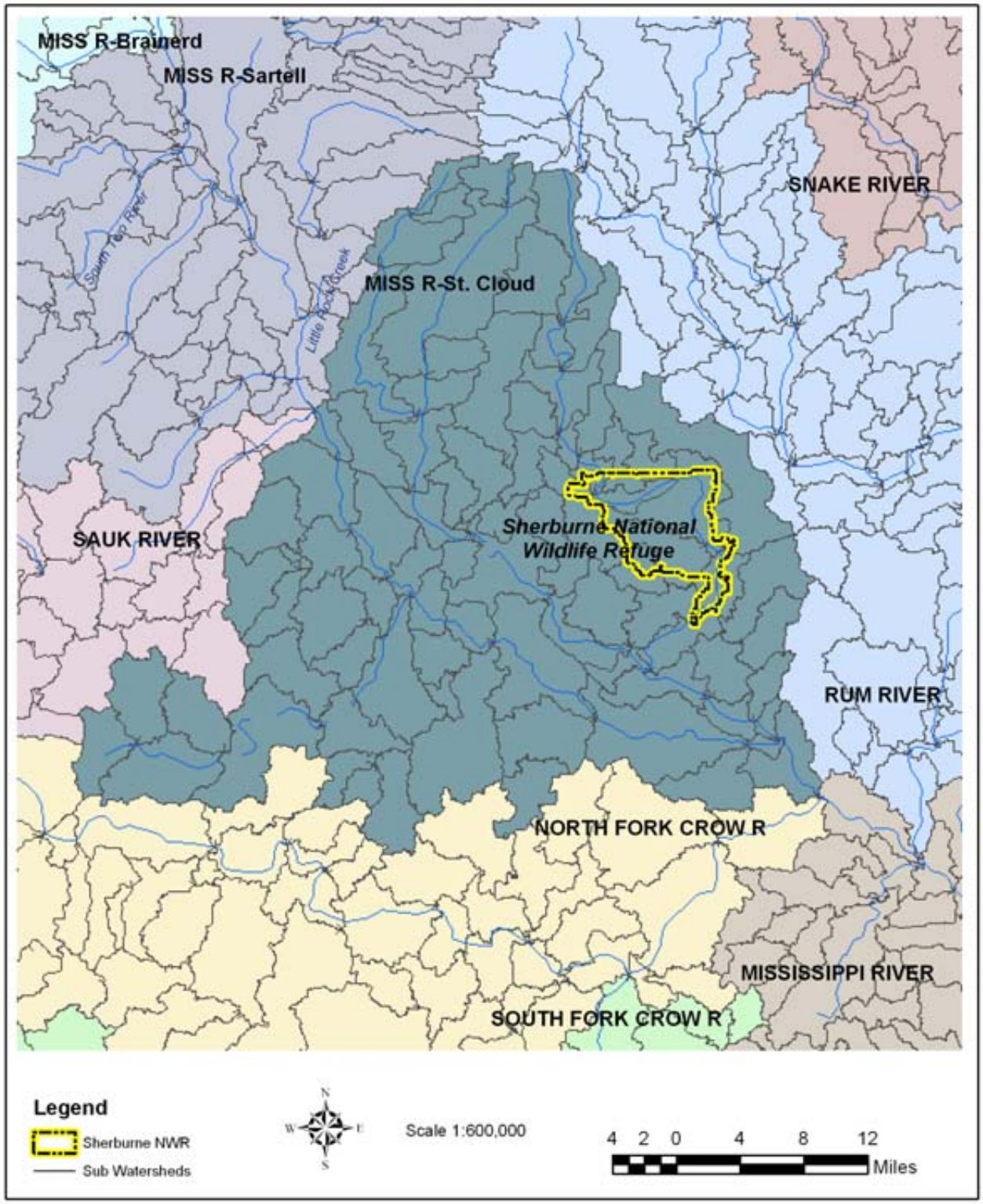
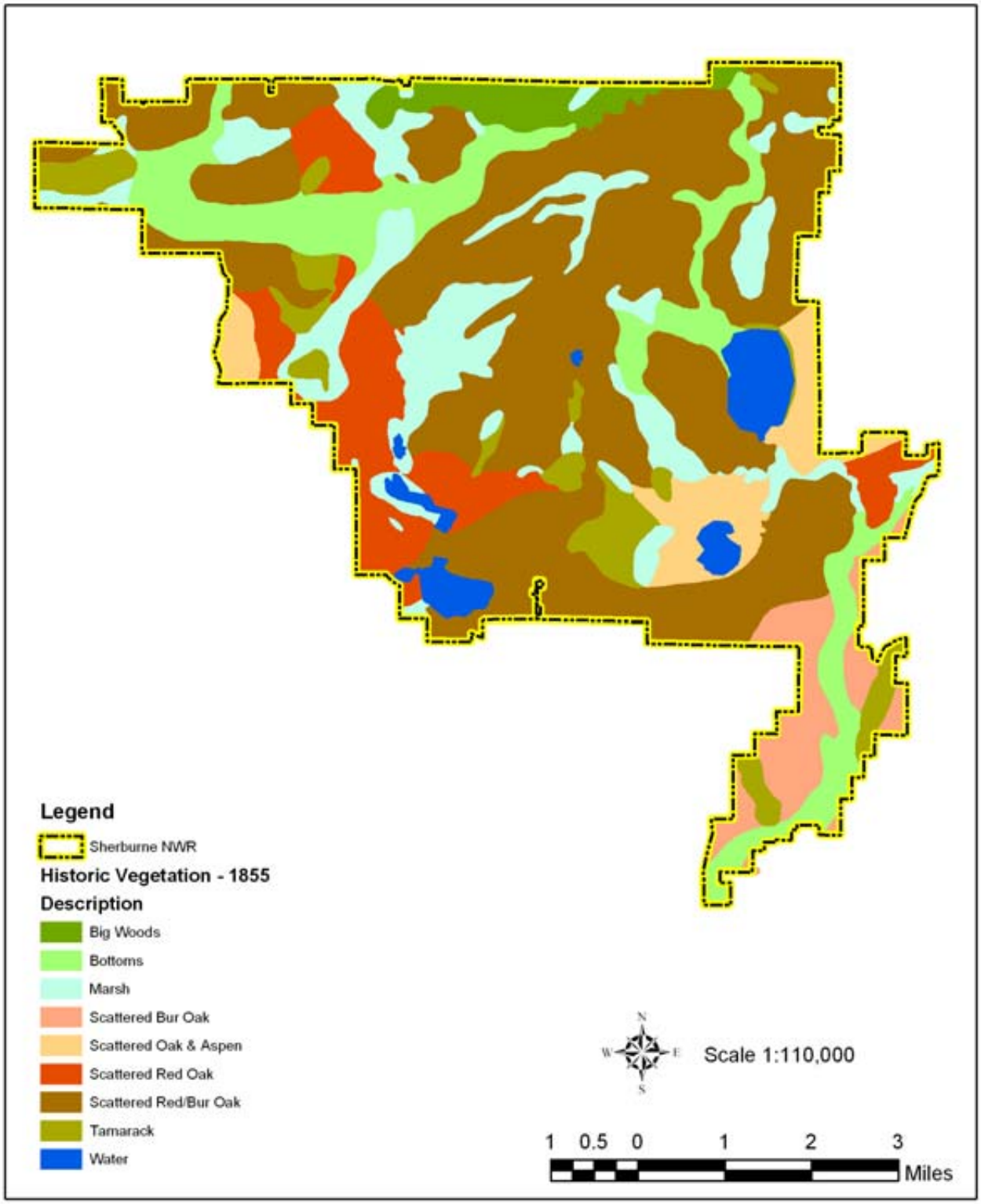


Figure 9: Historic Vegetation on Sherburne NWR, 1855



landowners followed the State's example and began planting pine and spruce on their own lands, including lands now held by the Refuge. At the time of Refuge establishment (1965) there were approximately 970 acres of conifer plantations (not including windbreaks) on what are now Refuge lands. With the many acres of conifer plantations being installed in the county, fire suppression became an even higher priority to both local residents and the State's Department of Natural Resources (DNR). From the 1940s until the present day, the policy of the DNR and local fire departments is to extinguish all wildfires, whatever their cause. With the present and projected urban interface, this policy has become more than socially acceptable – it has become a necessity for the protection of life and property.

Plant Communities

Following establishment of the Refuge in 1965, old agricultural fields began to be seeded into native warm season grass species. Fire began to be used as a tool, primarily to stimulate grassland plantings for dense nesting cover. Relative percent cover and distribution of vegetative cover types when the Refuge was established are shown in Figure 10.

The landscape of the Refuge at the time of establishment was dominated by agriculture in the form of cropped fields (32 percent of the land area). The next most dominant types were "Shrub Swamp" with 19 percent of the land area, and "Oak" with 17 percent of the land area. Much of the Oak type was probably grazed by domestic livestock. Wet meadows had approximately 10 percent of the land cover and mixed hardwoods dominated 6 percent. Conifer plantations at the time occupied about 970 acres, roughly 3 percent of the Refuge's acreage.

As a result of management practices at the Refuge and the cessation of farming on Refuge lands, vegetative communities rapidly changed following establishment of the Refuge. An impoundment system installed in the early 1980s reflooded, and expanded previously drained wetlands. Figure 11 displays present day (2000) vegetative cover type distribution and relative percent cover information.

During the more than 30 years since the Refuge was established, wetland areas have increased from 34 percent relative cover to 45 percent relative cover. This is significant in terms of fire management as many of these wetlands (with the exception of "Open Water") are dominated by emergent vegetation that falls into fuel model 3 of the Fire Behavior Fuel Model System.

Another significant change during this period is the increase of native tallgrass types (also fuel models 1 and 3), which have climbed from 1 percent in 1968 to 27 percent in 1998. At the same time, cultivated fields that accounted for 32 percent of the Refuge in 1968 have disappeared.

Refuge vegetation goals today are directed primarily by the Refuge's Landscape Plan. These goals include returning upland vegetation to, as close as possible, a "pre-settlement" state. Many of the goals were based on the native plant communities of state-wide significance as referenced in the publication "Natural Communities and Rare Species of Sherburne County, Minnesota" (MnDNR 1993). Today's plantings and seedings, in light of these goals, include a large variety of native forbs, grasses and trees, in an effort to restore native plant communities. Fire is being used on most upland types to open forest canopies and restore/maintain native plant associations and structures.

Wetlands

The Refuge contains a variety of wetlands ranging from shallow wet meadows to permanently flooded mixed emergent marshes. During the restoration of wetlands on the Refuge, dikes with water control structures were placed on 23 ditches. Twenty-two of these structures are still in place and water levels are managed to control rough fish and greatly improve the productivity of the aquatic communities (Figure 12). Many species of waterfowl, marsh, and water birds are attracted to the resulting conditions in search of food and cover. Purple loosestrife, although not found universally, does occur in some of these wetlands and is a major concern.

Figure 10: Vegetation on Sherburne NWR at Time of Establishment, 1968

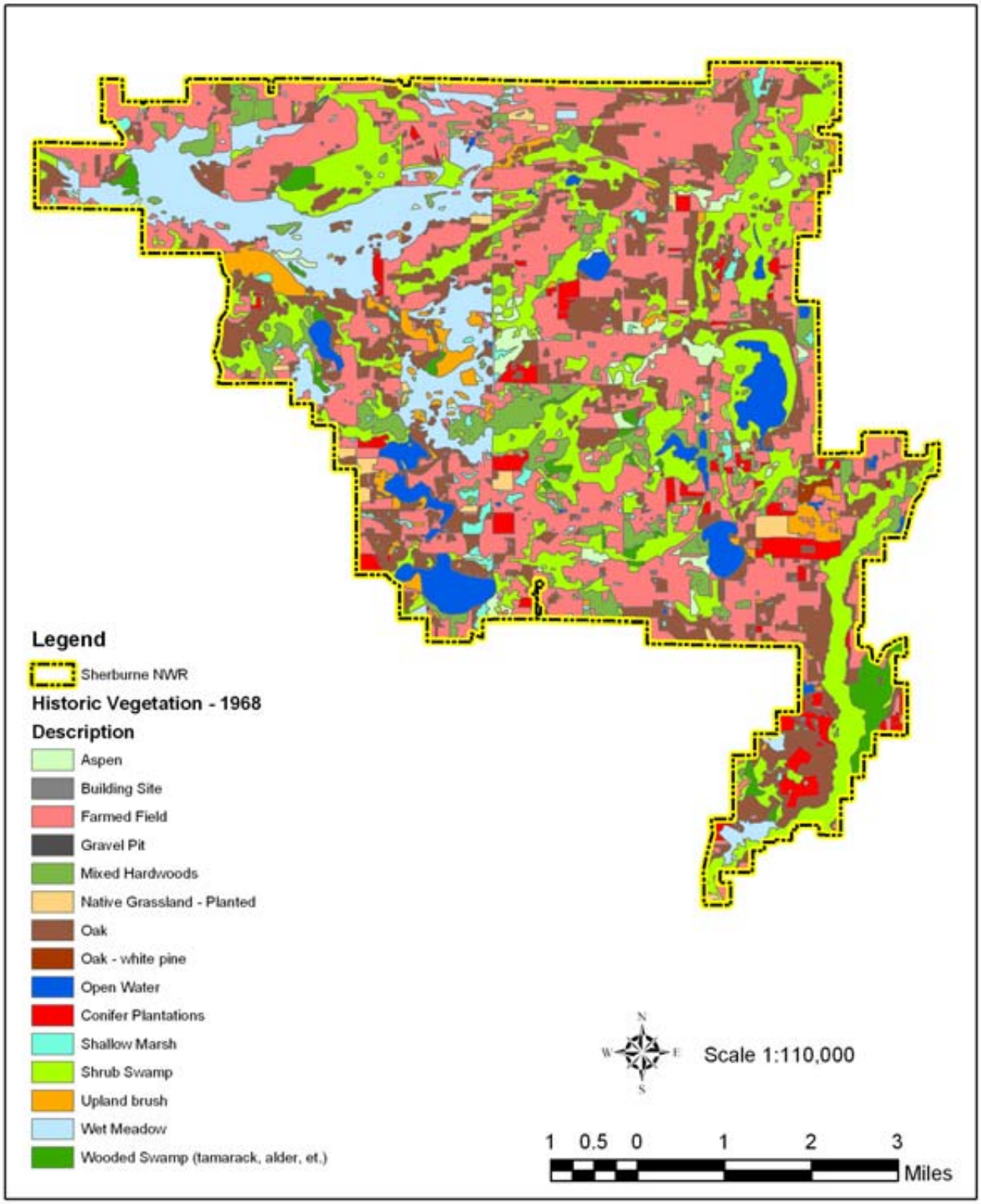


Figure 11: Current (1999) Vegetation, Sherburne NWR

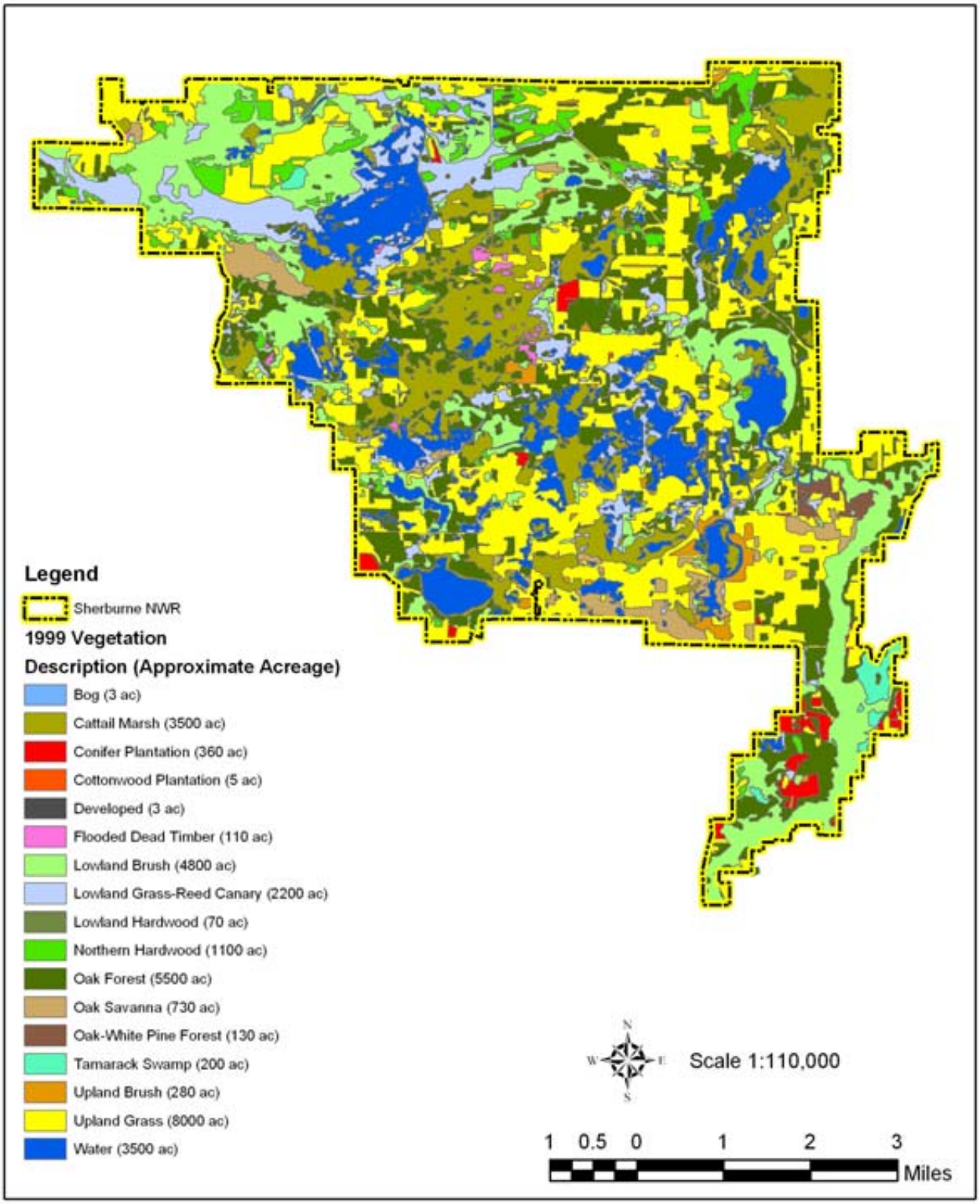
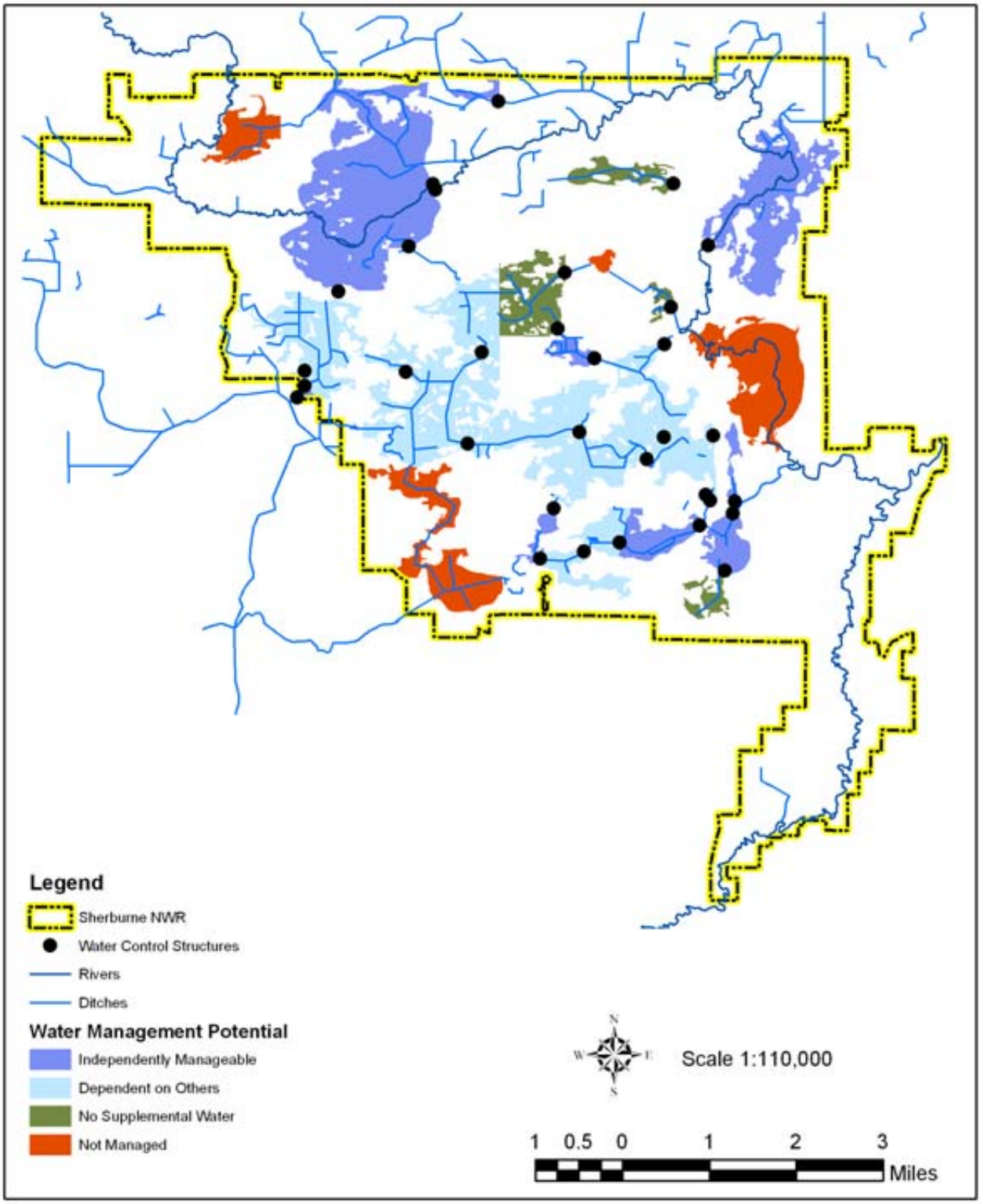


Figure 12: Water Management Potential, Sherburne NWR



An Historical Look at Wetlands

The Sherburne NWR encompasses 30,569 acres of wetlands according to the National Wetland Inventory. The wetlands of Sherburne NWR were affected by two man-made environmental changes; 1) drainage prior to the Refuge establishment, and 2) flooding after the impoundments were in place and operational. The following analysis looks at both of the these events with the best available information.

This analysis is based on early survey summaries by Marschner, wetland data from the National Wetland Inventory, soil data from the 1968 Soil Survey of Sherburne County and the 1997 soils data from National Resources Conservation Service (NRCS), and Soil Survey Geographic Database (SSURGO), prepared by Kevin Kenow and Jason Rohweder of the U.S. Geological Survey (USGS), ecoregion and watershed data from the Minnesota Department of Natural Resources Data Deli, and the Refuge-specific GIS vegetation surveys and other data developed by Gary Swanson of the Sherburne NWR and summarized by USGS.

Summary of Wetland Changes

During presettlement times, 44 percent of the acres within the current Refuge boundaries were wetlands. During the 1930s, 2,152 wet acres were drained resulting in 34 percent of the Refuge in wetlands (Figure 13). In the early 1970s the impoundment system returned more than the original wet acres and now 46 percent of the Refuge is wet.

The effect of these changes can be seen in the vegetation and water levels on the Refuge. The early wetland vegetation of the 1850s was primarily wet meadows; there was no reference to cattail and trees were thin and located in woody swamps (Figure 9). When the wetlands were drained in the 1930s, wetlands changed to shrub-scrub and forested swamps with an increase in woody vegetation and decrease in wet meadows. After the impoundments were in place in the early 1970s, the shrub-scrub wetlands decreased while cattail marshes increased. Figure 14 provides a visual overview of this trend; notice that the woody vegetation in wetlands (Figure 15) peaked at the time of the Refuge was established (late 1960s), but through a combination of management approaches, it has almost returned to the areas originally identified in the early 1850s surveys.

Wild rice is not identified in the vegetation surveys of Sherburne NWR, however the transcripts in the 1960s on the reasons why a refuge was necessary cited a decline in wild rice as one reason why waterfowl had declined in the area.

After the impoundments, the major change has been in the amount of open water identified in the various surveys (Figure 16 and Figure 17). There has been an increasing amount of open water on the Refuge since its inception. Open water signifies an area of water without emergent vegetation. The overall trend is of increasing open water on the Refuge. Since 1994, the Refuge has increased water management to hold pools to lower levels and this has developed the amount of open water.

A History of Drainage

The history of wetlands at Sherburne NWR parallels wetland development throughout the agricultural portion of Minnesota. During the early 1900s, county ditch systems were established to drain wetlands and convert them to cropland. Establishment of private ditch systems followed. The county ditch systems on the Refuge were established between 1900 and 1920. Private drainage continued until the establishment of the Refuge in 1965 (Figure 13).

The St. Francis River runs a winding course north and south through the Refuge. The Watershed of the river originally encompassed 59,171 acres or 92 square miles (Figure 8). But the drainage system created in the early 1930s and continuing to this day increases the effective size of the watershed to as

Figure 13: Drained Wetlands at the Time of Refuge Establishment, Sherburne NWR

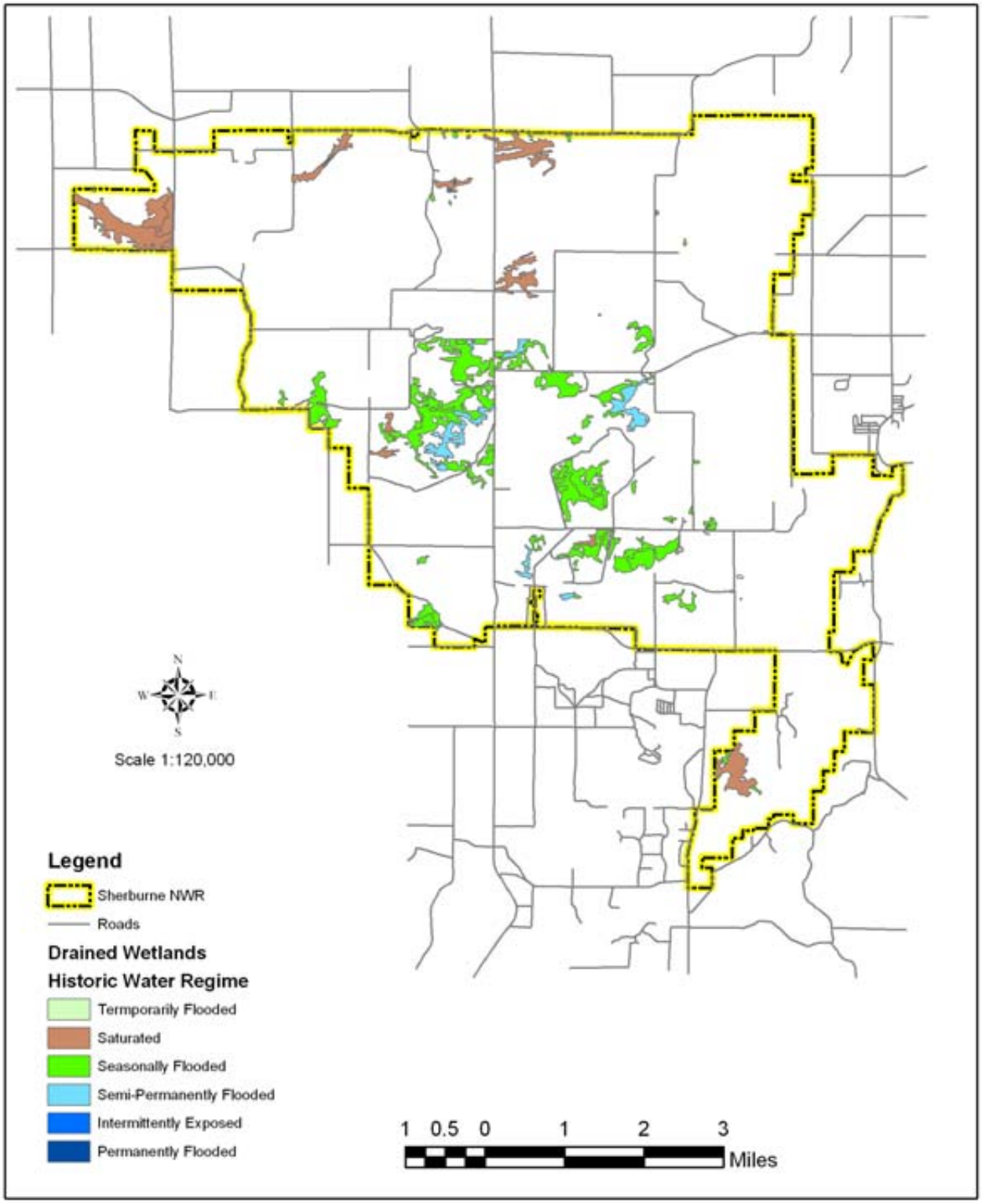


Figure 14: Changes in Woody Wetland Vegetation Over Time, 1855, 1968, 1999, Sherburne NWR

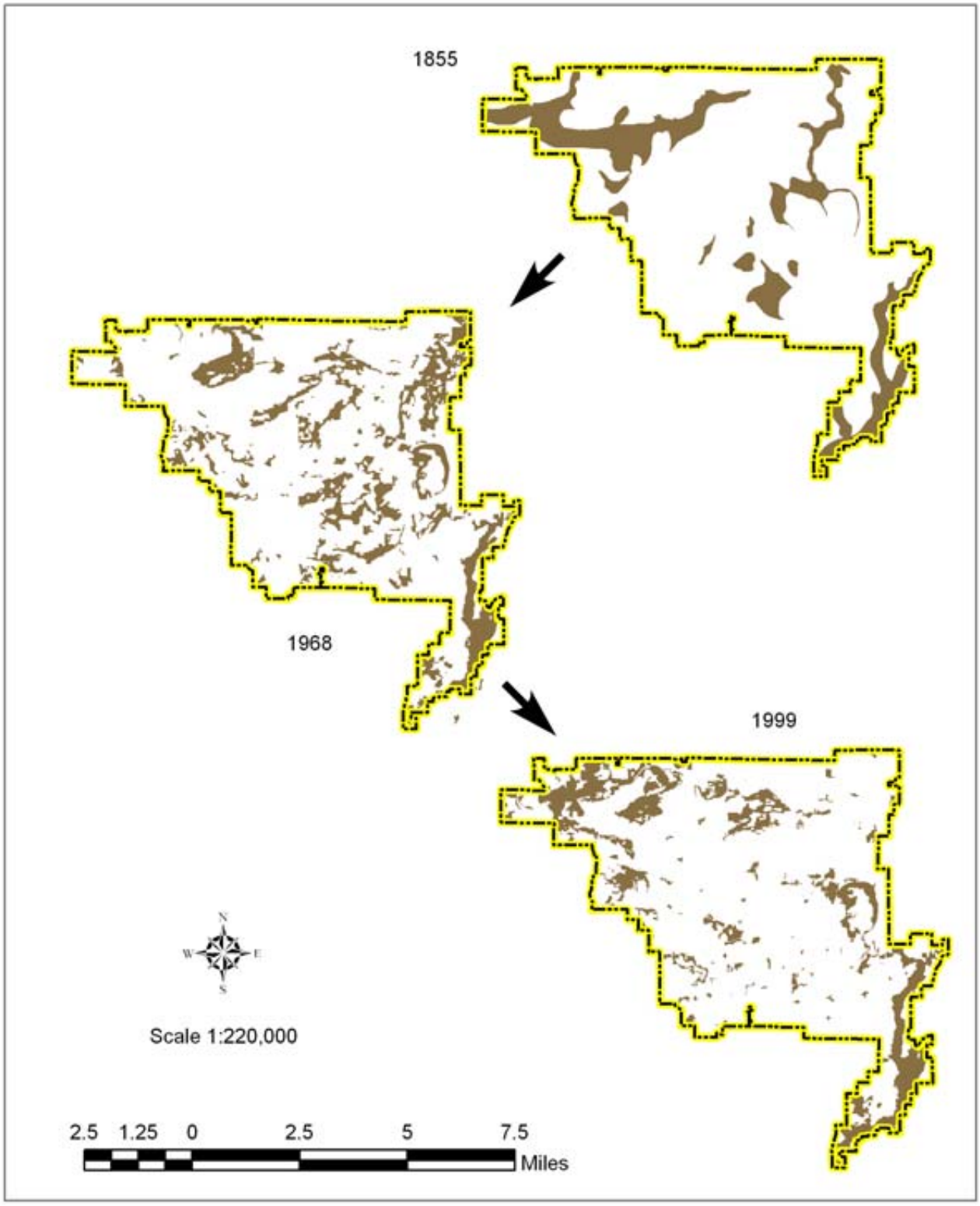


Figure 15: Historic Wetland Vegetation, 1968 and 1999, Sherburne NWR

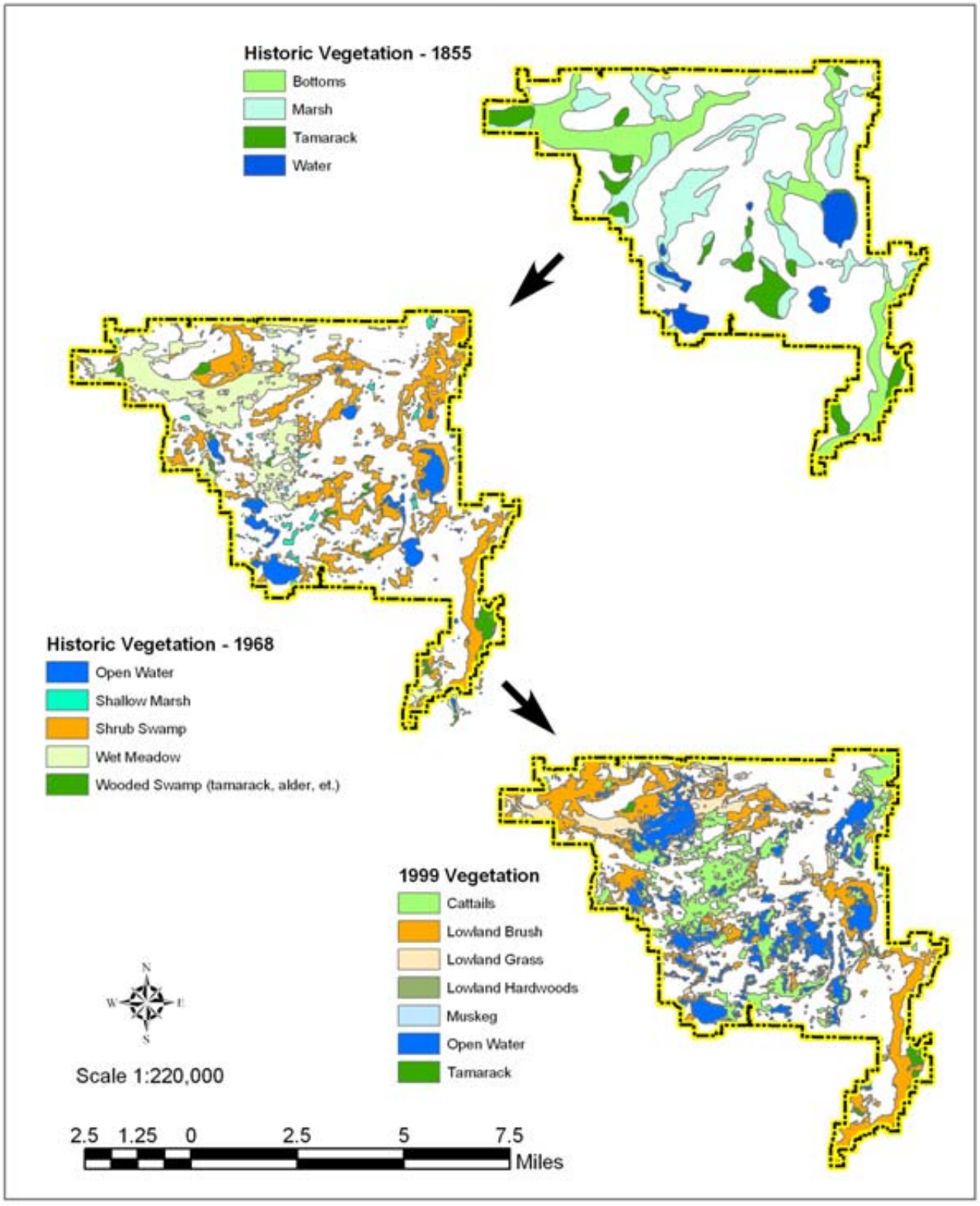


Figure 16: Increases in Open Water Over Time, 1855, 1968, 1999, Sherburne NWR

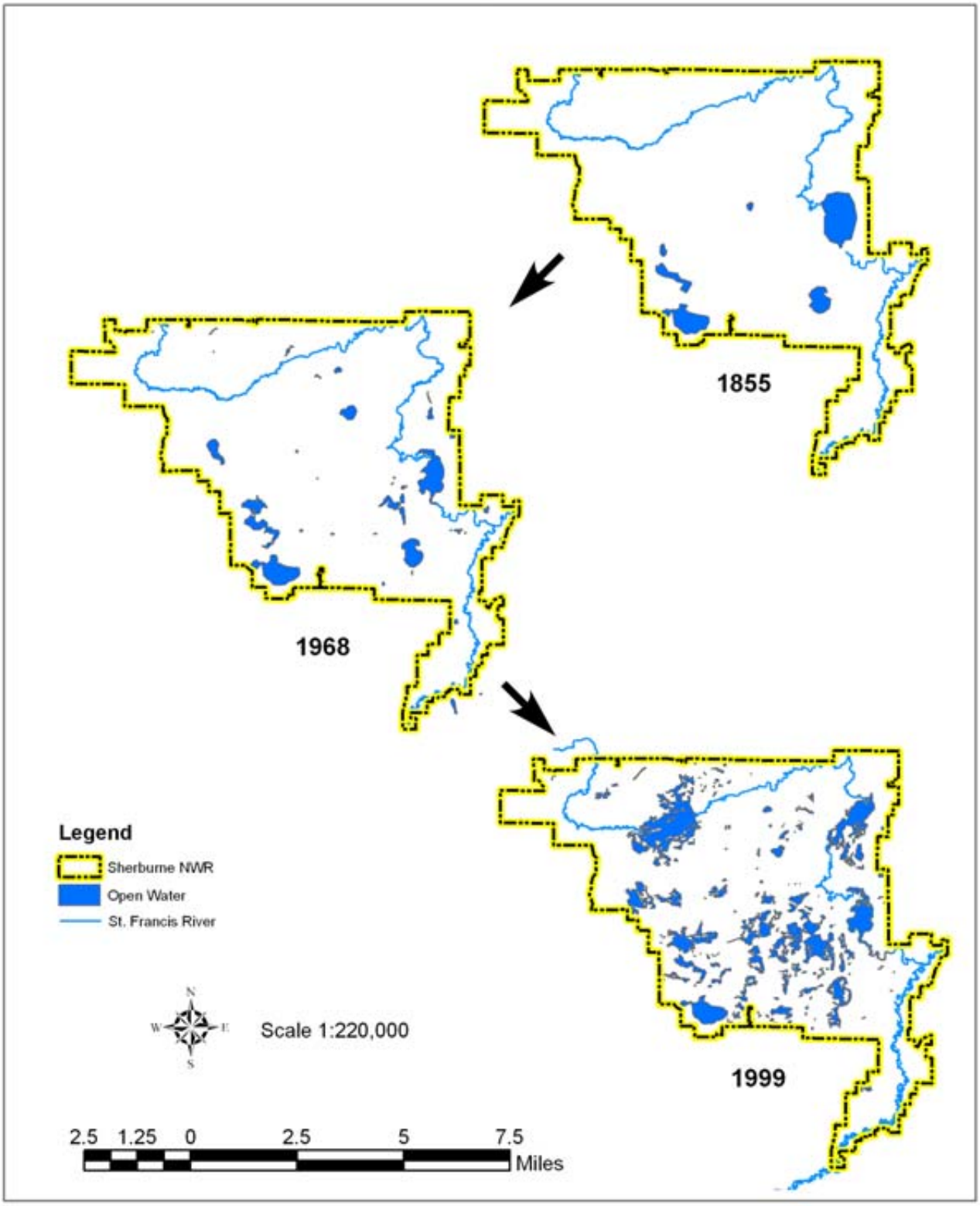


Figure 17: Flooded Uplands, Sherburne NWR

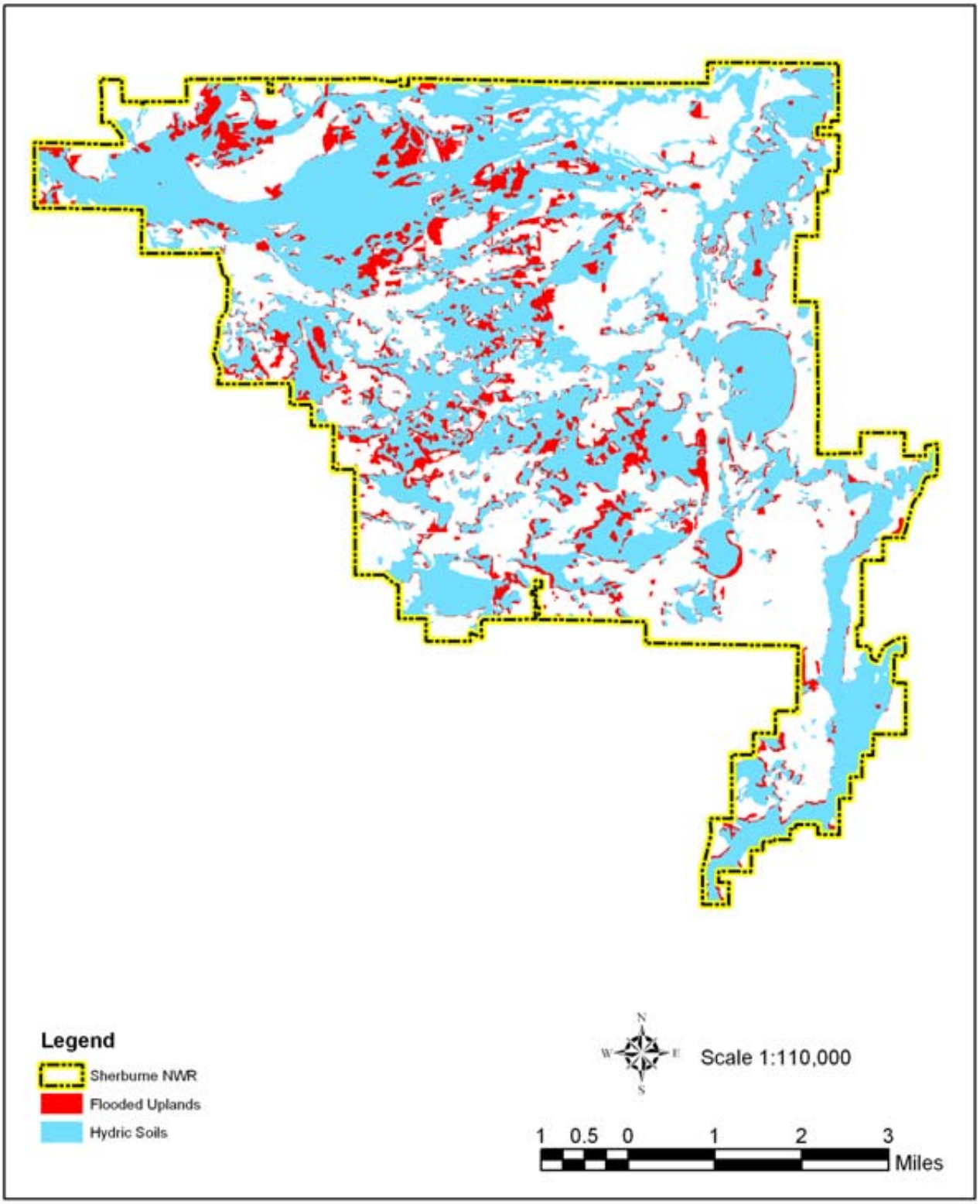


Table 3: National Wetland Inventory Data Wetlands by Type

Water Regime	Acreage
Temporarily Flooded	188
Saturated (wet meadow)	4,594
Seasonally Flooded (wet meadow)	4,792
Semi-permanently Flooded (marsh)	2,306
Intermittently Exposed (marsh)	432
Permanently Flooded (open water)	305
Total Wetlands	12,617

large as 214 square miles. The St. Francis River Watershed, a subwatershed of the St. Cloud-Mississippi River Watershed, crosses into the Rum River Watershed as a result of ditching.

Drainage of the larger wetlands was generally inadequate for conversion of the basins to crop land. Surface waters were removed but the soils remained waterlogged. When the Refuge was established, the area was heavily ditched; 130 basins were drained and many of the wetlands were affected by drainage (Figure 13). Drained wetlands were disproportionately the wet meadows known in Cowardin et al. as saturated and seasonally flooded wetlands, also drained were the shallow shrub-scrub wetlands. The shrub-scrub wetlands and other woody wetlands so prevalent in the early 1970s were probably the result of failed drainage. The woody vegetation moved in and dominated many wet areas (Figure 14). The combination of woody vegetation and the loss of the shallow, seasonally flooded wetlands probably contributed to declines in breeding waterfowl and many other types of marsh birds, such as shorebirds, rails, cranes, and bitterns in the area.

The large, shallow sedge wetlands were the easiest to drain and the NWI data reflects this result.

Impoundments and Wetland Flooding

After the Refuge was established, impoundments were created in an effort to mitigate the earlier drainage. As a result, most of the Refuge wetlands were affected by the resulting flooding of the impoundments. Open water increased from 818 acres in the late 1960s to 3,508 acres in 1992. Total wetland acres increased from 10,464 in late 1970s to 14,023 acres in 1992. All of the wetlands were affected by the impoundment flooding. Using hydric soils as a conservative estimate of wetland acres prior to alteration by ditching, the construction and flooding of the impoundments resulted in 2,910 acres of the uplands (non hydric soils) being flooded. The flooded uplands are generalized throughout the Refuge as could be expected from a raised water table (Figure 17).

Uplands

Oak Savanna

In pre-European settlement times, the distribution of oak savanna in the Midwest was widespread. It occupied up to half of midwestern landscape, especially along the prairie-forest border and extended over portions of Minnesota, Iowa, Missouri, Illinois, Wisconsin, Indiana, and Ohio, covering 11 to 13 million hectares (27.5 to 32.5 million acres) (Nuzzo, 1985). Since then, these places have become fragmented and in many areas lost entirely. A survey of this plant community by Nuzzo in 1985 found about 0.02 percent of the pre-European oak savanna remaining in scattered remnants. Losses of oak savanna were due to timber cutting, fire suppression (which converted it to oak woodland and forest), and conversion to homesteads and/or farming (pasture, crop fields). Today, oak savanna and open oak woodlands are among the world's most threatened plant communities. The Nature Conservancy ranks Midwest savannas as “globally endangered” (Leach and Ross, 1995) and the U.S. Environmental

Protection Agency chose midwestern oak savanna for its first Ecosystem Recovery Project (Leach and Ross, 1995). As described elsewhere in this chapter, 95 percent of the Refuge's upland was considered oak savanna by Marschner (1930) at the time of European settlement. Today, 732 acres exist on the Refuge as remnants of this important plant community.

Grasslands

Very few small, scattered tracts of native prairie exist on the Refuge, amounting to less than 1,000 acres. These rare and unique grasslands include both mesic and dry prairie and they are frequently interspersed with woodland areas, especially forested sites protected from periodic fires. Mesic prairie is dominated by tall grasses including big bluestem and Indian grass. Medium-height grasses such as little bluestem and side oats grama dominate dry prairies. Both mesic and dry prairies found on the Refuge contain shrubs, such as leadplant and wild rose. Pasque flower, purple prairie clover are commonly found in both plant communities.

Native grassland restoration has occurred for many years on some upland sites of the Refuge and on private lands in the area through the Partners for Fish and Wildlife Program. Former croplands are typically planted to native grass mixtures consisting of big bluestem, little bluestem, switch grass, and Indian grass. A mixture of forbs is also included to enhance the biological diversity of many of these sites.

Fish and Wildlife Communities

The habitats described in the preceding section support an array of wildlife species that are common to east central Minnesota. A rich diversity of birds, mammals, fish, reptiles, and amphibians inhabit lands administered by Sherburne National Wildlife Refuge. (See Appendix C for a Sherburne NWR species list.)

Birds

Background:

The Refuge attracts over 230 species each year to its diverse habitats (Appendix C). Of these, over 120 are known to nest in the area. The Refuge wetlands provide habitat for about 30 nesting pairs of Greater Sandhill Cranes and serves as a staging area for thousands of cranes during fall migration. During fall and spring migration, the Refuge wetlands also support thousands of waterfowl, including Trumpeter Swans, Canada Geese, Wood Ducks, Northern Pintail, Ring-necked Ducks, Mallards, Gadwall, American Wigeon, Northern Shoveler, and Green-winged Teal that use the Refuge as a place to rest and feed along their journey. Common nesting waterfowl of the area include Canada Goose, Mallard, Wood Duck, Blue-winged Teal, and Hooded Merganser.

Other marsh and water birds frequently utilizing the Refuge and surrounding areas include Green Heron, Double-crested Cormorant, Great Blue Heron, Sora, Virginia Rail, and American and Least Bitterns. Exposed mud flats that occur sporadically around the edges of Refuge wetlands attract shorebirds including Greater and Lesser Yellowlegs and Spotted Sandpiper. Both Common Snipe and American Woodcock are commonly found on these lands as well.

Songbirds attracted to the woodland and open grassland areas on the Refuge include Eastern Kingbird, Indigo Bunting, Eastern Meadowlark, Bobolink, Scarlet Tanager, and Brown Trasher which use these upland areas for nesting and raising their young. Several species of warblers and other neotropical migrants pass through the Refuge regularly in the spring on their migration to northern breeding grounds. Year-round residents include Downy, Hairy, Pileated and Red-bellied Woodpecker, Wild Turkey, Ruffed Grouse, and Ring-necked Pheasant. Birds of prey inhabiting Refuge lands include Bald Eagle, Red-tailed Hawk, Red-shouldered Hawk, American Kestrel, Sharp-shinned Hawk, Northern Harrier, and Cooper’s Hawk.

Mammals

The Refuge lies within the known breeding range of 54 mammal species (Appendix C). Of these, 46 species have been confirmed on the Refuge. Two species, bison and elk, known to historically reside on Refuge lands, were extirpated in the early 1900s.

The largest land mammals currently residing and breeding on the Refuge are black bear and white-tailed deer. Small mammals typical of this area include short-tail shrew, white-footed mouse, thirteen-lined ground squirrel, and deer mouse. Eastern chipmunks, eastern gray, fox, and red squirrels are commonly found in wooded habitats. Both big and little brown bats use the Refuge and its associated lands. Coyote, red fox and gray fox are the most common carnivores of the area. Bobcat are also found on the Refuge. Mammals attracted to aquatic habitats in the Refuge include river otter, mink, muskrat, raccoon, and beaver.

Reptiles and Amphibians

Twenty-three species of reptiles and amphibians have been reported on the Refuge but little is known about their populations or their limiting factors. Many of these, such as the snapping and painted turtles, are associated with marsh and open waters while others, such as the common garter snake and the hognose snake, occur in oak savanna and prairie.

Fish

Like most other fresh water systems in the United States, high populations of carp inhabit the St. Francis River. Due to regular spring flooding, many of the Refuge wetlands contain a diversity of fish that originate in the river. For some species, these wetlands offer spawning and nursery habitat.

State Species of Concern

Several State-listed animal species are known to occur on the Refuge as migrants, breeders, and/or occasional visitors.

State-listed endangered species:

- Henslow's Sparrow

State-listed threatened species:

- eastern spotted skunk
- Trumpeter Swan
- Peregrine Falcon
- Loggerhead Shrike
- Horned Grebe
- Bald Eagle
- Forster's Tern
- Hooded Warbler
- Blanding's turtle

State listed as special concern:

- gray wolf
- least weasel
- plains pocket mouse
- Red-shouldered hawk
- Yellow Rail

- # smooth softshell turtle
- # snapping turtle
- # western hognose snake
- # gopher snake
- # two jumping spiders

Of these species, the Bald Eagle, snapping turtle, Blanding's turtle, and gopher snake would be considered common.

Threatened and Endangered Species

The federally-listed threatened Bald Eagle is known to breed on the Refuge. In 2004, there were seven active Bald Eagle nests. Since eagles first nested on the Refuge in 1983, almost 100 eagles have been produced.

Transient individuals of the federally listed gray wolf also frequent the Refuge. No established packs occur on the Refuge.

Threats to Resources

Invasive Species

Several invasive species exist on the Refuge, most of which are exotic species, that have the potential to significantly affect the diversity and quality of important wildlife habitats and natural vegetation restoration efforts. Currently, leafy spurge, Siberian elm, and black locust pose the greatest threats in the upland areas, followed by European buckthorn, spotted knapweed, and coniferous tree species not native to area before European settlement such as scotch pine, white spruce, red pine, and Colorado spruce. Box elder and aspen are invasive native species that also pose potential problems in upland restoration areas.

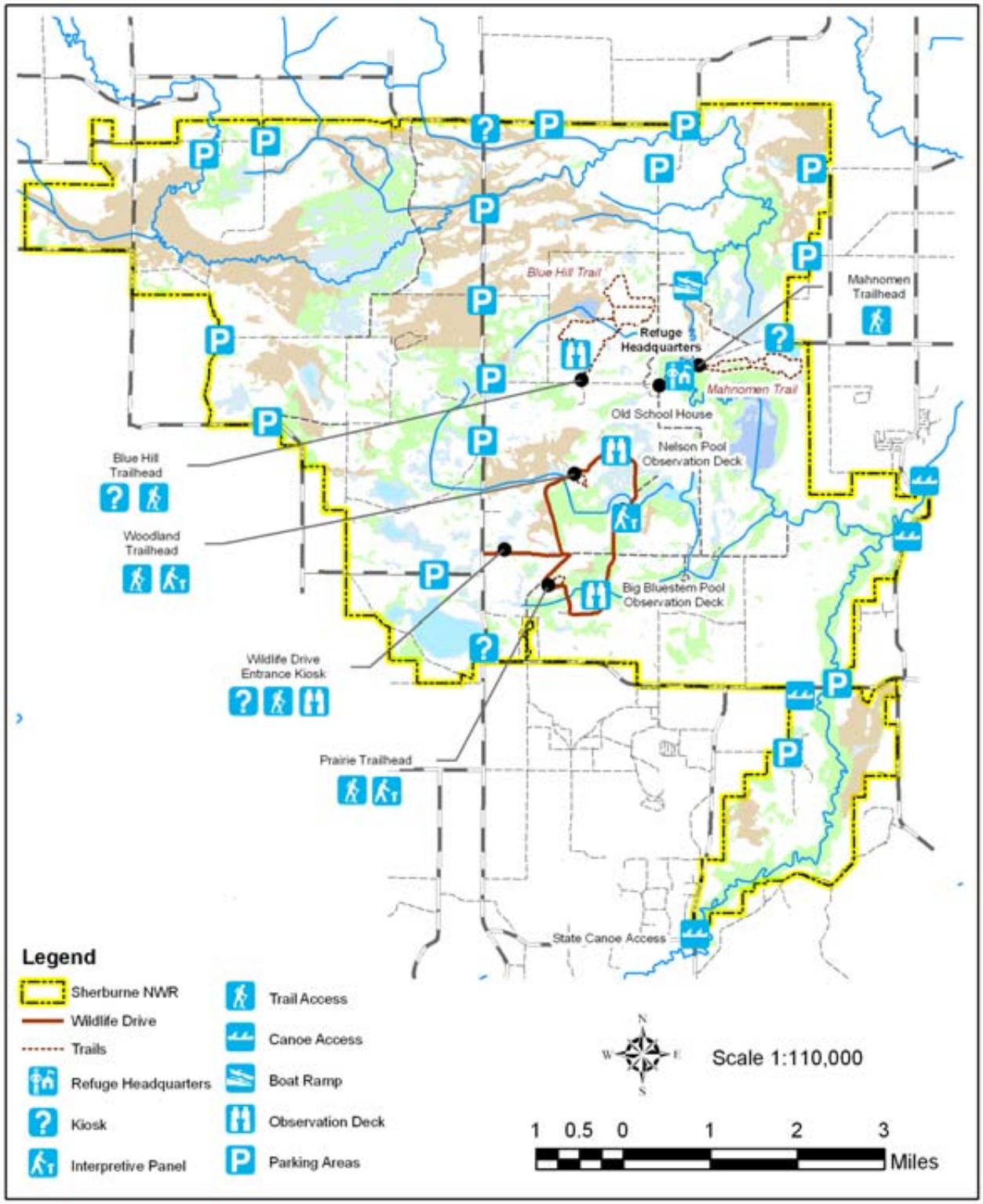
Purple loosestrife is the major exotic species in wetland areas on the Refuge and currently affects at least one-third of the restored wetlands. Reed canary grass is another aggressive species found in wetland areas on the Refuge that can reduce the quality of these areas to wildlife. Eurasian water milfoil also has potential to adversely impact Refuge wetlands and has been found within the watershed above the Refuge.

Administrative Facilities

Located near the east entrance, the Refuge headquarters is a renovated home with a few additions made through the years (Figure 18). A schoolhouse, constructed early in the 20th century near the Refuge headquarters, has been converted for use as a meeting hall and environmental education facility. The schoolhouse is the center of public use programs on the Refuge.

In 2001, a new maintenance facility was completed for the Refuge. The main building contains a fire bay, heated shop with offices, carpenter shop and storage bay. A large pole barn provides additional storage for Refuge equipment. A four-stall garage provides cover for Refuge vehicles and small equipment.

Figure 18: Current Facilities, Sherburne NWR



Archeological and Cultural Resources

Cultural resources are important parts of the Nation's heritage. The Service is committed to protecting valuable evidence of human interactions with each other and the landscape. Protection is accomplished in conjunction with the Service's mandate to conserve fish, wildlife, and plant resources.

Cultural resources are "those parts of the physical environment – natural and built- that have cultural value to some kind of sociocultural group…[and] those non-material human social institutions…" Cultural resources include historic sites, archeological sites and associated artifacts, sacred sites, traditional cultural properties, cultural items, (human remains, funerary objects, sacred objects and objects of cultural patrimony), and buildings and structures.

Archeological evidence indicates people of all major cultural traditions have occupied the Refuge area from the end of the last glacier to the present time. Paleo-Indian sites, based on the contents of a privately owned collection, would be very important to the State of Minnesota. An archeological resource survey was conducted early in the Refuge's history, with only 1 percent of the Refuge surveyed, there are 53 known sites. The Refuge contains two important Woodland period mound groups and associated villages. The Refuge has 20 reported archeological collections totaling almost 17,000 items. These collections are stored primarily at the Minnesota Historical Society, with a smaller collection at Mississippi Valley Archaeology Center. There was also a National Register of Historic Places property known as the Glidden-Fox house that was moved to the Town of Becker. There are four additional sites on the Refuge that are eligible for the National Register of Historic Places. All four sites are of Native American origin and are sub-surface. They include archeological sites No. 13 and No 14 (Lane 1974), the northern mound group burial site (Lane 1969) and the southern mound group burial site (Lane 1969). While not on the National Registry, the Grundrude Cemetery is a pioneer family cemetery near Orrock and is of local historical significance.

Wildlife-dependent Recreation

The average annual visitation to the Refuge between 1998 and 2003 was 95,951. Visitors participate in bird, upland game, and deer hunting, fishing, wildlife observation and photography, and environmental education and interpretation. Participation in these wildlife-dependent recreation activities is displayed in Table 4.

In preparation for comprehensive planning, visitors to the Refuge were surveyed from April 2001 to April 2002. The survey was a cooperative effort with the University of Minnesota Department of Forest Resources and Minnesota Cooperative Fish and Wildlife Research Unit. The survey results are available in a report, "Sherburne National Wildlife Refuge: A Study of Visitor Experiences and Preferences in Support of Comprehensive Conservation Planning." The surveyors contacted 760 visitors. A detailed survey was completed by 451 respondents.

In the survey we learned that most respondents were white and had at least a high school degree. Approximately 40 percent had a college degree. About 25 percent live in rural communities. Over half of the respondents traveled 20 miles or fewer to visit the Refuge.

Respondents were given a list of activities that they could participate in while on the Refuge. The five activities with the greatest participation were: watching wildlife, observing on the Wildlife Drive from a vehicle, viewing scenery, bird watching, and looking at wildflowers. The five activities engaged in least often were: hunting from disability blinds, mushroom picking, fishing from a canoe, cross-country skiing off-trail, and berry picking. Participation in activities varied across seasons. Hunting, of course, occurred in the fall during open seasons.

Table 4: Participation in Public Use Activities, Sherburne NWR

	1998[1]	1999	2000	2001	2002	2003
Total Refuge Visitation	86,881	102,261	93,049	88,365	94,000	111,151
Hunting						
Waterfowl	1,334	1,425	1,608	1,479	1,438	1,764
Upland Game	951	1,054	1,182	1,196	1,844	2,435
Big Game	3,594	3,928	4,300	3,831	4,446	4,251
Total	5,879	6,407	7,090	6,506	7,728	8,450
Fishing	1,991	2,095	1,670	1,420	1,341	1,958
Interpretation, Observation, Photography						
Wildlife Drive	18,000	20,654	19,445	16,977	18,547	24,942
Foot Trails	15,000	18,659	18,465	17,240	17,837	22,795
Special Events	1,539	1,862	1,542	1,431	1,061	1,388
Total	34,539	41,175	39,452	35,648	37,445	49,125
Environmental Education						
Staff/volunteer-led	2,002	1,539	1,359	1,092	1,037	1,233
Teacher-led	3,517	1,331	1,591	1,421	1,694	1,145
Total	5,519	2,870	2,950	2,513	2,731	2,378

1.Years presented are U.S. Fish & Wildlife Service fiscal years, which run from October through September.

To identify the motivations important to visitors, respondents were asked to rate how important 32 experiences were to them in relation to their most satisfying recreational activity at the Refuge. The five experiences with the highest importance mean scores were to: experience nature, see wildlife, view scenic beauty, enjoy smells and sounds of nature, and get away from usual demands of life.

Visitors were asked to look over a list of 27 possible problems and rate how much the problem detracted from their experience. Mean scores indicate that none of the problems are more than a slight distraction from their experiences when looking across all respondents. However, about one-third of the respondents indicated that litter and trash left by others was a moderate to severe problem for them. One-third of the respondents also indicated that people not following hunting regulations and people not obeying Refuge rules detracted moderately to severely from their experience. Visitors were also asked about the number of other visitors they saw at various places on the Refuge. In general, respondents did not feel crowded. About a third of visitors reported the number of people in the field while hunting deer with firearms as somewhat to very unacceptable. In addition, a little over 20 percent of visitors found the number of people in the field while hunting waterfowl was unacceptable.

Visitors were asked to rate their support or opposition to 17 possible management actions. Respondents slightly supported: controlling invasive species, closing access to promote nesting, providing more educational opportunities, and providing more exhibits. Respondents slightly opposed: decreasing prescribed burning, limiting number of hiking trails, providing fewer hunting opportunities, and providing fewer information signs. Approximately a third of the respondents strongly opposed providing fewer hunting opportunities.

Finally, visitors were asked about their general feelings about the Refuge, the staff, and the Fish and Wildlife Service. Overall, respondents most strongly agreed that the time they spent at the Refuge could not have been spent elsewhere. They identify strongly with the Refuge and see it as an important place for their children and future generations. Respondents generally agreed that they feel welcome at the Refuge. They trust that the U.S. Fish and Wildlife Service will make good decisions, have confidence in the local staff, and believe that the staff will do what is best for the Refuge.

Analysis of the survey data reveals several major trends that should be addressed in future management decisions. First, and most importantly, visitors greatly appreciate the recreational opportunities and other benefits the Refuge provides. Secondly, distinct user groups visit the Refuge and each group has its own special needs. Conflicts between groups could potentially cause problems and efforts should be made to avoid this. Building positive, strong relations between visitors and between visitors and Refuge managers will not only improve experiences on the Refuge, but will also create a sense of community and connectedness among Refuge visitors. Actions promoting a positive social environment will also enhance visitor support and dedication to the Refuge and will more firmly establish the Refuge's role within the community.

Maintain and Improve Current Opportunities at the Refuge

Although a wide range of preferences exists, Refuge visitors are very satisfied with current recreation activity and experience opportunities at the Refuge. Managers should make efforts to maintain the diversity of activities available and improve techniques used to inform visitors and enhance experience opportunities. Visitors will be better able to achieve recreational goals and pursue interests if they are aware of the possibilities. For example, signs, brochures, and maps can clearly direct people to locations suitable for hiking, observing wildlife, biking, hunting, or other activities appropriate to the Refuge. Additionally better and/or timelier information can help visitors attain and benefit from their desired experiences.

Observing wildlife and scenery were the most popular visitor activities. It is therefore important that visitors have a variety of viewing opportunities. Current viewing locations, such as observation platforms, trails, and the wildlife drive, should be monitored to ensure sites continue to provide opportunities to see a Great Blue Heron, a fading summer sunset, and so on. Over time, modifications may need to be made to viewing stations and perhaps new ones created.

Educating visitors can also help visitors attain and benefit from experiences they value. For example, Refuge visitors reported that they highly value observing wildlife. But, they also reported they were not able to attain this experience to their desired level. Often, spotting wild animals takes practice and patience. Visitors may be looking at the wrong time of day, in the wrong type of habitat, or may need to be quieter on trails or on the wildlife drive. Interpretive programs or signs could provide visitors with hints on how to improve their observation techniques to enhance their wildlife viewing opportunities. Letting visitors know what types of animals they should be looking for in a specific area might also improve their success.

Visitors were also interested in learning more about nature in general and the natural history of the area. Several individuals expressed interest in guided Refuge tours and the establishment of a permanent educational center. While an education center may not be an immediate possibility, an increase in educational/ interpretive programs, signs, brochures, and activities will help satisfy this visitor need. Programs could be designed and led by volunteers if budgetary or other constraints exist.

Creating a Sense of Community Among Refuge Visitors

Creating a community atmosphere among Refuge visitors can result in substantial and far-reaching benefits. Although most visitors had very few complaints regarding their visit to Sherburne National

Wildlife Refuge, some did report feelings of crowdedness or the presence of too many people. In addition, it seems that many visitors would benefit from a better understanding of other individuals with differing recreational interests. Learning to appreciate a variety of recreational interests and values could help alleviate feelings of crowdedness and conflicts between visitors.

The survey data reveals distinctions between fall and summer visitors. Winter/ spring visitors were very similar in most aspects to summer visitors. Differences in attitudes, perceptions, and interests can lead to varying degrees of conflicts between visitors. Currently there does not appear to be any severe problems, however, the potential exists. By encouraging all types of visitors to interact or learn more about different viewpoints, managers can help improve visitors' relationships with one another. Better understanding of fellow visitors is vital to acceptance of others and to the construction of a visitor community.

One area that deserves attention is hunting. A large number of respondents support hunting on the Refuge and enjoy hunting on the Refuge. Others believe that the Refuge should serve as a haven for wildlife and hunting should be excluded. Hunting is an essential tool managers use to keep wildlife populations in balance with the habitat resources. Programs concentrating on the role of hunting in wildlife Refuges – and Sherburne NWR in particular – could be implemented to inform visitors of the benefits of hunting to wildlife populations as well as to continued visitor opportunities to view wildlife.

Compared to summer and winter/spring visitors, fall visitors appear to place less importance on the Refuge's role in managing habitat for wildlife, retaining and restoring ecosystem functions, preserving natural landscapes, and providing educational opportunities for visitors. A majority of fall visitors are hunters. Perhaps more than other groups, hunters should be targeted with information and education efforts to increase their knowledge and understanding of the Refuge's many different goals. A better understanding on the part of hunters on the role of the Refuge would improve the relationship between hunters and non-hunters. It might also increase support for management strategies and tactics designed to eliminate or decrease visitor caused damage to resources and other visitors' experiences.

Another way to foster a sense of community among Sherburne NWR visitors is to encourage volunteerism and membership in the *Friends of Sherburne* group. Currently the Refuge has a large and active volunteer force – one out of every seven visitors volunteers time at the Refuge engaging in activities such as collecting prairie seeds to serving as an interpreter along the wildlife drive during summer – and an active *Friends* group. Although a diversity of volunteer opportunities exists, the list of volunteer activities could be expanded to include a greater diversity of visitors. Retaining dedicated volunteers contributes immensely to creating a sense of community and shared values between visitors and staff.

Current Refuge Programs: Where We Are Today

Sherburne National Wildlife Refuge conducts a wide array of wildlife conservation activities both on and off the Refuge. Over the years, a variety of habitat management approaches has been applied to the Refuge. Many of these practices were aimed at improving Refuge lands for waterfowl production, an historic focus of the U.S. Fish and Wildlife Service. In 1999, the Refuge, with the input of other conservationists, assessed its habitat restoration and management programs and developed a Landscape Plan. This plan basically set forth the philosophy of restoring Refuge plant communities to native species. It also identified the importance of using natural processes such as prescribed fire and water management to maintain the diversity and productivity of these communities. This philosophy remains today and will be integral within this Comprehensive Conservation Plan.

The Refuge's proximity to urban areas also offers unique opportunities to interact with diverse and supportive audiences. For example, Refuge staff have the privilege to work with a large cadre of

Table 5: Wildlife Observation Visitors, Sherburne NWR

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Total Refuge Visitation	86,881	102,261	93,049	88,365	94,000	111,151
Wildlife Drive	18,000	20,654	19,445	16,977	18,547	24,942
Foot Trails	15,000	18,659	18,465	17,240	17,837	22,795

dedicated volunteers. Environmental education programs are provided to area schools from suburban or rural locations. Likewise, hunting, fishing, wildlife observation, photography, and interpretive opportunities are offered on Refuge lands.

Current Visitor Use on the Refuge

Wildlife Observation and Photography

The Refuge is open to the public for wildlife observation and photography for a variety of activities during daylight hours. On average, more than 74,000 visitors participate in wildlife observation and photography each year while using the wildlife drive, using hiking trails, canoeing on the St. Francis River or bicycling on Refuge roads (Table 5). The 7.3-mile Prairie's Edge Wildlife Drive provides vehicle and bicycle access for wildlife viewing in wetlands, oak savannas, prairie openings, and woodlands. The Drive is open from late April through October. The Blue Hill and Mahnomen trails provide nearly 8 miles of easy walking and are open year-round. Each trail is designed with three loops that pass through oak woodlands and prairie openings, skirting nearby wetlands. When snow has accumulated, these trails are open for cross country skiing. Snowshoeing and walking are permitted to the side of ski tracks on the Mahnomen Trail. Canoeing is permitted on Battle Brook and on the St. Francis River south from Battle Brook. Bicyclers are welcome on the Wildlife Drive from late April through October, and on Refuge service roads from September 1 to February 28. Hiking trails are closed to bicyclists and off-road travel is not permitted.

A Haven for Wildlife – March 1 to August 31

The majority of the Refuge is posted for no entry from March 1 to August 31. This period gives wildlife the chance to breed and raise their young without human disturbance. During this period, the Blue Hill and Mahnomen Hiking Trails, the Wildlife Drive, the St. Francis River canoe route, and fishing access points remain open for public use.

Special Events/Outreach

Five special events are annually co-sponsored by the Refuge and the Friends of Sherburne: the Wildlife Festival in October, the Wildlife Film Festival in January, Winterfest in February, Spring Clean-up in April and Migratory Bird Day in May. These events provide an excellent avenue for public outreach and education (Table 6).

Environmental Education

Sherburne County Environmental Education (EE) Days are annually held during the third week of September at Sherburne NWR and Sand Dunes State Forest. Nearly 900 fifth and sixth grade students from Elk River, Zimmerman, Otsego, Becker, Clear Lake and Foley participate in the program. Each student spends a half-day at the Refuge and a half- day at Sand Dunes State Forest participating in a variety of 20-minute environmental education programs conducted by staff from the Refuge, the University of Minnesota Extension Service for Sherburne County, the Natural Resource Conservation Service, Minnesota Department of Natural Resources, and the Sherburne County Soil and Water Conservation District. The Refuge is responsible for programs on wildlife management and prescribed burning.

Table 6: Special Event Attendance, Sherburne NWR

Special Events	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Wildlife Festival	350	600	575	600	200	400
Wildlife Film Festival	228	111	83	38	87	99
Winterfest	700	800	500	425	375	500
Spring Clean-up Day	200	300	350	300	340	340
Migratory Bird Day	54	35	24	50	42	29
TOTAL	1,532	1,846	1,532	1,413	1,043	1,368

Table 7: Total Environmental Education Participation, Sherburne NWR

Environmental Education	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Staff/volunteer-led on-site	2,002	1,539	1,359	1,092	1,037	1,233
Teacher-led on-site	3,517	1,331	1,591	1,421	1,694	1,145

Table 8: Days of Use by Hunters, Sherburne NWR

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Waterfowl Hunting	1,334	1,425	1,608	1,479	1,438	1,764
Upland Game Hunting	951	1,054	1,182	1,196	1,844	2,435
Big Game Hunting	3,594	3,928	4,300	3,831	4,446	4,251

In addition to the EE Days program, teachers lead their own programs on the Refuge with planning assistance from staff. Staff and volunteers also lead programs upon special request (Table 7).

Hunting

Small game, waterfowl, and big game hunting are permitted on the Refuge for certain species, in designated areas, in accordance with state and federal laws. Seventeen off-road, mowed parking areas are provided for hunters. Long Pool is the most heavily hunted location on opening weekend of waterfowl season with an average of 44 hunters on the pool. Opening day of firearms deer hunting averages over 900 hunters (Table 8). Three waterfowl blinds and one firearms deer blind are provided for hunters with disabilities during waterfowl and firearms deer season.

Fishing

Fishing is enjoyed on the St. Francis River at six designated access points marked on the Refuge recreation map. State regulations apply (Table 9).

Table 9: Days of Use by Anglers, Sherburne NWR

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Anglers	1,991	2,095	1,670	1,420	1,341	1,958

Table 10: Volunteer Hours, Sherburne NWR

	1998[1]	1999	2000	2001	2002	2003
Volunteers	503	745	574	717	546	603
Volunteer hours	8,866	8,662	8,001	8,733	7,752	8,603

1. Years presented are U.S. Fish & Wildlife Service fiscal years, which run from October through September.

Volunteer Program

Volunteers actively participate in a wide variety of visitor services and biological programs. Their activities include litter pick-up, trail maintenance, roving wildlife interpretation, wildflower gardening, prairie seed collections, and wildlife surveys. From 1998 to 2003 volunteers contributed an average of 8,436 hours each year (Table 10). Many accomplishments would not be possible without the contributions of these dedicated individuals..

Friends Group

The Friends of Sherburne NWR, a non-profit group formed in 1993, assists the Refuge with educational programs and provides financial backing for selected programs and projects through fund-raising activities. At the end of fiscal year 2003, the Friends had 248 members.

Habitat Management on the Refuge

The primary objective of the habitat management program at the Refuge is to maintain diverse, productive, and sustainable native plant communities. Through periodic treatments, these lands maintain their value to Refuge wildlife and help meet their production, feeding, and migration requirements. The major habitat types of the Refuge can be divided into three categories; wetlands, big woods, and oak savanna.

Wetlands

The Refuge lies within the St. Francis Watershed and contains a variety of wetlands ranging from shallow wet meadows to permanently flooded mixed emergent marshes. After the Refuge was established, impoundments were created along the existing agricultural drainage ditches. Open water increased from 818 acres in the late 1960s to 3,508 acres in 1992. Total wetland acres increased from 10,464 in late 1970s to 14,023 acres in 1992.

Sherburne National Wildlife Refuge has 22 restored wetlands, or impoundments, where the water level can be manipulated. Not all of the impoundments are kept at the same depth. Water management by controlled fluctuations creates a variety of habitats to provide for a diversity of wildlife requirements. Water level management is the primary technique used to maintain the diversity and productivity of Refuge impoundments. Through periodic drawdowns, followed by subsequent reflooding, they support a variety of aquatic emergents and expose mudflats that attract good concentrations of waterfowl, waterbirds, and shorebirds.

Big Woods

Big woods, sometimes referred to as a maple-basswood forest, was historically dominated by these two tree species but also includes elm, red oak, and green ash. Canopy cover is 80 to 100 percent. The understory is comprised of shade tolerant herbaceous plants such as ironwood and sugar maple, sparse shrub layer, and a diverse ground layer of mesic forest herbs.

Woodlands near the northern boundary of the Refuge are managed to maintain native trees and restore a Big Woods habitat. Snags and downed timber are retained for use by wildlife for roosting, loafing, nesting, hunting, feeding, and food storage.

Oak Savanna

Historically, oak savanna was the predominant habitat on the upland areas that are now part of the Refuge. This plant community is characterized by scattered individuals and clumps of oaks growing with an understory dominated by tall grasses and prairie flowers. Oak savanna was historically a very dynamic habitat, fluctuating into a more open or less open state depending on frequency of wildfires or drought. It was associated with the more open prairie areas and also more dense oak woodlands and brushlands. Today, woodland areas and prairie openings on the Refuge are considered a part of the oak savanna.

The Refuge is reestablishing prairie grasses and wildflowers that once dominated the oak savanna through an active planting program. Big bluestem, little bluestem, Indian grass and switch grass, as well as a rich diversity of native prairie wildflowers (forbs) can now be found here. The sandy soils on the Refuge provide well-drained growing conditions for many plants more typically found in more arid regions of the west. Several species of wildflowers, such as lupine, hoary puccoon, and Indian paintbrush, are found in the Refuge at the limits of their range. Oak seedlings are being planted in some portions of the Refuge to restore the overstory of the oak savanna while in other areas oaks are naturally spreading into the grassland plantings.

Oak savanna is a fire-dependent plant community that today is restored and maintained by prescribed burning. Burning serves three primary functions. It encourages the growth of native wildflowers and warm season grasses, such as big and little bluestem, Indian grass and switch grass, which provide food and cover for nesting waterfowl and wildlife. It also reduces competition from exotic cool season grasses and encroaching trees and shrubs that are not fire tolerant. In addition, prescribed burning opens up the canopy in more heavily wooded areas to re-create oak savanna.

The Refuge's fire program focuses on prescribed burning for habitat and wildlife management and wildfire control. Though the main reason for conducting prescribed burning is to restore and maintain a healthy Refuge ecosystem, fuel reduction for wildfire management is also a benefit. Prescribed burning consumes dead vegetative fuels under controlled conditions, reducing the wildland fuel load. Reducing these fuel loads under controlled conditions facilitates the suppression of wildfires, should they start. This is particularly important because the Refuge lies in an area that has a lot of residential development.

Table 11 shows the history of fires on the Refuge from 1986 to 2002.

Invasive Species Control

The overall strategy for the control of exotic and aggressive native species is to reduce the use of chemicals and use mechanical and biological means where possible and effective. Efforts will be concentrated on those species posing the biggest threat to natural vegetation restoration efforts. The understanding is that some exotic species will be a part of today's landscape because they are too prolific to expel of but do not pose a major threat, e.g., hoary allysum and noble yarrow.

The Refuge has control programs in place for some species. An aggressive chemical control program for Siberian elm and black locust was begun many years ago and has made much progress in getting these species under control. Problem areas have been reduced to small patches and, at the present rate, total control should be realized in 10 years.

In addition to chemical control, the Refuge has an active biological control program in place for purple loosestrife and leafy spurge. Currently, purple loosestrife infestations range in size from a few plants to approximately 400 acres (i.e., Long Pool) with the larger infestations occurring on the eastern half of the Refuge. Purple loosestrife has become established on approximately 835 acres of the Refuge; the exotic plant can be found on 13 of our impoundments, Rice Lake, Buck Lake, Type 2/3/4 wetlands, Battle Brook, and the St. Francis River. However, some of the impoundments contain less than a

Table 11: History of Fire on Sherburne NWR

Year	Wildfires		Prescription Burns		Total Acres
	Number	Acres	Number	Acres	
2002	4	2.3	15	6604	6,606.3
2001	5	25	1	946	971
2000	4	2.7	9	4,743	4,745.7
1999	7	12.6	6	4,120	4,132.6
1998	11	60.5	10	6,426.0	6,486.5
1997	2	16.0	5	3,459.0	3,475.0
1996	3	1,299.6	3	3,357.0	4,656.6
1995	10	329.9	5	4,103.0	4,432.9
1994	1	12.0	4	466.2	478.2
1993	4	7.1	7	2,490.0	2,497.1
1992	3	5.5	8	6,821.0	6,826.5
1991	4	72.1	7	2,574.0	2,646.1
1990	3	913.5	1	1,200.0	2,113.5
1989	1	0.3	5	4,334.0	4,334.3
1988	5	748.2	0	0.0	748.2
1987	2	3.0	3	1,495.0	1,498.0
1986	1	.3	2	392.0	392.3

quarter of an acre of infestation. To date, an estimated 187,000 leaf-eating beetles (*Galerucella* sp) have been released at 49 locations on-Refuge and thirteen private land sites within the Refuge's watershed. Root-boring weevils (*Hylobius* sp) have also been released at five locations including one private land site.

An integrated pest management approach is used for leafy spurge. Chemical methods are used to treat small patches (i.e., < 2500 sq ft) of leafy spurge. However, larger infestations are treated with flea beetles of the *Aphthona* species as the biological control agent. To date, we have released 128,710 flea beetles at 27 locations. Approximately 24 of the Refuge's total 45 acres of infestation have been treated with biological agents. The main target area for leafy spurge is in the vicinity of Bergerson, Bohm, and Josephine Pools where the invasive plant appears to be spreading.

Non-native conifer species are mainly controlled through mechanical means. Plantations of these trees in existence when the Refuge was established are harvested commercially when they reach merchantable size. About 65 percent of the non-native conifers present on the Refuge have been controlled in this manner. Scattered individuals in active burn units are left to be controlled by fire.

Fish, Wildlife, and Plant Monitoring

The monitoring of fish, wildlife, and their habitats at the Refuge is conducted to provide information used to make management decisions and support statewide and national conservation efforts. Fish, wildlife, and plant monitoring activities currently occurring on the Refuge are summarized as follows:

Waterfowl Survey: Waterfowl surveys are conducted weekly during spring and fall migrations and biweekly between migration times. The data are used to provide managers and the public with current information on the distribution and abundance of waterfowl using the Refuge, and to identify annual trends in waterfowl use.

Water Bird Survey: conducted in conjunction with waterfowl survey, this survey provides data on the distribution of these birds, their chronology of use, and monitors long-term trends in use of the Refuge habitats.

Bald Eagle Survey: All Bald Eagle nests on the Refuge are monitored weekly by staff and volunteers to obtain phenology and productivity data. All information is shared with the DNR Nongame Program, which monitors nesting activity throughout the state.

White-tailed Deer Harvest Data: Sex, age, and kill data is collected on an annual basis during the firearms deer season. This information is used to help track the harvest and contributes to the Minnesota DNR population model that helps set management goals for the upcoming season.

Sandhill Crane Surveys: A spring unison call survey is conducted annually to estimate the number of breeding pairs of Greater Sandhill Cranes. In the fall, counts are done as the cranes leave their roost to estimate the number of cranes utilizing the Refuge for a staging area. Both of these surveys track long-term trends of crane use of the Refuge.

Predator and Furbearer Scent Post Survey: This survey is conducted annually to determine the relative distribution and abundance of these species on Refuge lands. In addition, this information is provided to the Minnesota DNR for incorporation into its statewide database.

Herptile Drift Fence: Baseline presence-absence information was established from annual surveys conducted from 1996-2000. These surveys will be repeated for 2 consecutive years every 5 years to monitor long-term trends.

Frog and Toad Calling Survey: Frog/toad calling surveys are conducted annually at specific sites to determine population status and diversity. The survey methods were adopted from the North American Amphibian Monitoring Program. The data collected is shared with Minnesota Frog Watch, which administers the Minnesota frog/toad survey efforts.

Waterfowl Harvest Survey: Each year a survey is done by checking the age, sex and species harvested during the waterfowl season. This information is used to track the composition of the harvest and hunter success rate.

Breeding Bird Survey: A road-based Breeding Bird Survey is conducted each year by volunteers. The results are incorporated into a national database to track distribution and trends of songbirds.

Habitat-based Breeding Bird Point Counts: Every 3 to 5 years point counts are performed for 2 consecutive years in three habitat types in an effort to track population trends and habitat associations of breeding songbirds. Sixty-eight points were sampled in 1994-95, and 2000-01.

Marsh Bird Survey: A survey of secretive marsh birds is conducted annually during the months of April, May, and June. Play-back calls are used to detect the presence of Yellow Rails, Virginia Rails, Soras, Least Bitterns, American Bitterns and Pied-billed Grebes. In addition, marsh and water birds are recorded during the waterfowl surveys.

Purple Loosestrife Monitoring: Annual reconnaissance is undertaken to track existing and new infestations of this invasive plant. In addition, the Refuge tracks the progress of biological control efforts by following a national protocol developed by Cornell University, an evaluation technique developed by the Minnesota DNR, and photo-points to document the effectiveness of biocontrol agents on loosestrife and monitor changes in wetland plant community.

Tamarack Swamp Restoration Monitoring: Permanent plots were established in an area where tamarack seedlings were planted in 1999 and 2000 in an effort to restore a tamarack swamp. These plots were set up to be sampled annually for the first 3 years and then on a semi-annual basis through 10 years to determine the survivorship, growth pattern, competition, and overall health of the trees.

Leafy Spurge Monitoring: Annual monitoring of areas where biological and chemical control methods have been used to determine the efficacy of these treatments in controlling the spread of this invasive species.

Bur Oak and Prickly Pear Reintroductions: These two species were planted at select Refuge sites in 1997 and 1998, respectively. All sites are monitored for survival and success of the plantings.

Prescribed Fire Monitoring: Following the protocol established by the National Park Service, 107 permanent plots are sampled pre-burn, immediately post-burn, and at intervals of 1, 2, 5 and 10 years after a prescribed burn is conducted. The purpose of this monitoring is to determine the long-term effects of the fire on vegetation composition and to determine if the objectives for the application of fire are being met.

Visitor Services

The majority of the Refuge is closed to all public access from March 1 to August 31 to allow wildlife to breed and raise their young free from human disturbance. During this time the Wildlife Drive (after the eagles hatch in late April), the hiking trails, the St. Francis River canoe route, and fishing access points remain available for wildlife-dependent recreation.

Hunting

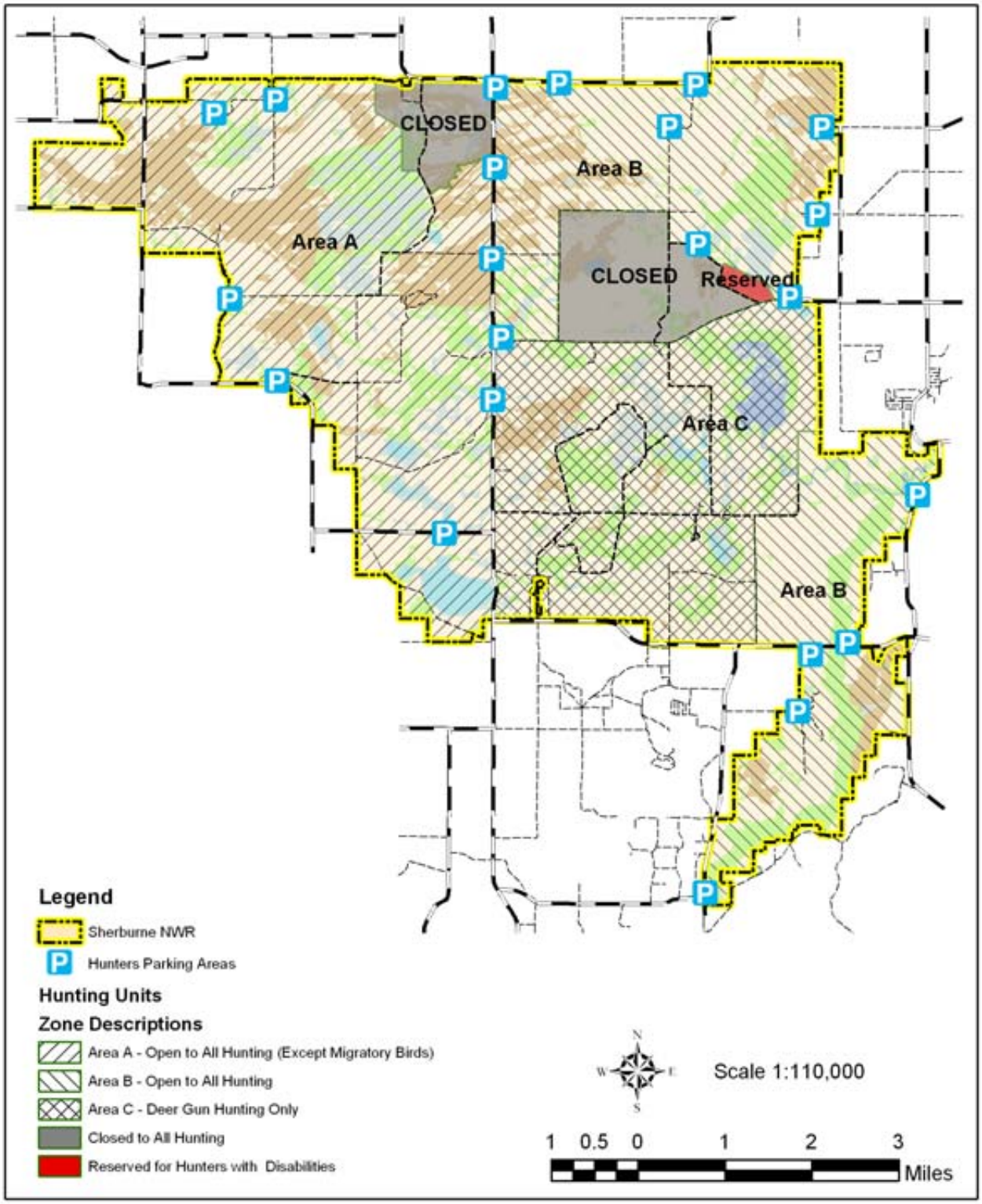
White-tailed deer is the most actively sought game mammal on the Refuge. The Refuge provides archery and shotgun hunting opportunities for white-tailed deer during the regular state seasons. Archery hunting is allowed in Refuge Hunting Areas A and B (Figure 19). Firearms hunting is allowed in Areas A, B, and C. During firearms-deer season, the Brande Road, off Co. Rd. 9, is closed to all access including foot travel. The Refuge is not open to bear, Wild Turkey, or special deer muzzleloader hunting.

The Refuge provides small game hunting for Ruffed Grouse, Pheasant, gray and fox squirrel, rabbit, and hare in Areas A and B during the regular state season for these species. Shotgun hunters must possess and use only non-toxic shot while hunting small game on the Refuge. The Refuge is not open to raccoon hunting.

Ducks, coots, geese, rails, woodcock, and snipe can be hunted in Area B of the Refuge during the regular state seasons. Hunters must remove boats, decoys and artificial blinds from the Refuge at the end of each day. Hunters can only use motorless boats, and they must be launched at designated access sites on Long Pool and the St. Francis River. Hunters are allowed to use dogs while hunting birds, but the dogs must remain under strict control.

During the waterfowl and firearms seasons, three waterfowl blinds and one firearms deer blind are provided by reservation for hunters with disabilities.

Figure 19: Hunting Areas, Sherburne NWR



Fishing

Fishing occurs at six access points on the St. Francis River. Anglers are primarily trying for northern pike, although carp and bullheads represent a large part of the fishery biomass.

Interpretation

Interpretation is provided at kiosks, interpretive signs along the wildlife drive, exhibits in the office, and through personal contact. Staff and volunteer wildlife interpreters give interpretive talks and demonstrations and lead tours. Interpreters contact visitors on the Wildlife Drive, lead bird hikes during special events, and conduct hayrides, presentations, and demonstrations at the annual Wildlife Festival and Winterfest special events. Interpretive themes include wildlife, wildlife management through water management and prescribed burning, upland habitat restoration through non-native tree removal and planting of native grasses and wildflowers, control of invasive plant species through biological and chemical programs. Five special events are held each year: Wildlife Festival, Wildlife Film Festival, Winterfest, Spring Clean-up Day, and Migratory Bird Day.

Environmental Education

Environmental education activities include staff and volunteer led programs on the Refuge, teacher led programs on the Refuge, and workshops offered to teachers. The Refuge also participates in the annual Sherburne County Environmental Education Days. During this event nearly 900 fifth grade students spend a half-day at the Refuge and a half-day at the Sand Dunes State Forest participating in a variety of 20-minute programs. The Refuge is responsible for programs on wildlife management and prescribed burning.

Wildlife Observation and Photography

Hiking, bicycling, canoeing, cross-country skiing, and snowshoeing are allowed in support of wildlife observation and photography. From mid-April through October, the 7.3-mile Wildlife Drive, the 5-mile Blue Hill Trail and the 3-mile Mahnomen Trail are open to wildlife observation and photography. The Wildlife Drive features three wildlife observation decks, the half-mile Prairie Trail, the half-mile Woodland Trail, and a quarter-mile accessible trail. During this period bicycling is permitted on the Wildlife Drive and on County roads crossing the Refuge. Bicycling is not permitted on hiking trails. In addition, from September 1 to February 28, Refuge service roads are open to bicycling, hiking, cross-country skiing and snowshoeing.

Most Refuge lands are open to hiking, cross-country skiing and snowshoeing from September 1 to February 28. The Brande Road is closed to all public entry during the firearms deer season. The Mahnomen and Blue Hill hiking trails are for hikers only. Bicycles and horses are prohibited on the trails.

Two ungroomed trails are available on the Refuge for cross-country skiing. The Blue Hill Trail has three moderate-grade loops and is open only to cross-country skiing. The Mahnomen Trail features three easy loops and is open to cross-country skiing, snowshoeing, and hiking.

During daylight hours, canoeing is permitted on Battle Brook south of Little Elk Lake and on the St. Francis River south of Battle Brook.

Mushroom and Berry Picking

The Refuge is open to recreational picking of berries, fruits, nuts and mushrooms for personal consumption within 100 feet of trails or public right of ways. Visitors are asked to be respectful of the needs of wildlife and never pick an area clean or destroy plants.

Law Enforcement

Enforcement of federal wildlife laws, as well as regulations specific to the Refuge System, is an integral part of Refuge operations. Law enforcement plays a crucial role in ensuring that natural and cultural resources are protected and that visitors encounter a safe environment. The Refuge currently has no officers who are commissioned to conduct law enforcement on federal property. However, federal law enforcement is a cooperative effort by many agencies in the region. Cooperative relationships and strategies have been developed with state conservation officers in the area and the Sherburne County Sheriff Department. Federal officers from other nearby Fish and Wildlife Service stations also help enforce the laws at Sherburne NWR.

Wilderness Review

As part of the CCP process, we reviewed lands within the legislative boundaries of the Refuge for wilderness suitability. The wilderness review process consists of three phases: inventory, study, and recommendation. In the inventory phase we look at Service-owned lands and waters within the Refuge that are not currently designated wilderness and identify those areas that meet the criteria for wilderness established by Congress. The criteria are size, naturalness, opportunities for solitude or primitive recreation, and supplemental values. Areas that meet the criteria are called Wilderness Study Areas (WSAs). In the study phase we develop and evaluate a range of management alternatives for the WSAs to determine if they are suitable for recommendation for inclusion in the National Wilderness Preservation System. In the recommendation phase we forward the suitable recommendations in a Wilderness Study Report that moves from the Director through the Secretary and the President to Congress.

No lands were found suitable for designation as Wilderness as defined in the Wilderness Act of 1964. The Refuge does not contain 5,000 contiguous roadless acres nor does it have any units of sufficient size to make their preservation practicable as Wilderness. Lands acquired for the Refuge have been substantially affected by humans, particularly through agriculture and transportation infrastructure.

Farm Services Administration Conservation Easements

Sherburne NWR has 47 Conservation Easements in its eight-county district. The breakdown is as follows: five easements in Isanti County, five easements in Benton County, eight easements in Kanabec County, 11 in Mille Lacs County and 18 in Pine County. Most, if not all, of these easements were a result of Farmers Home Administration (FmHA) debt restructuring. Conservation Easements were placed on the wetland areas to safeguard them for the future. Some of these easements are managed by the Minnesota DNR.

Habitat Management: Private Lands Program

Sherburne NWR is responsible for an eight-county Refuge Management District. Refuge staff assist private landowners with wetland and grassland restoration projects in this District, primarily through the Partners for Fish and Wildlife Program. Wetland restorations occur primarily through plugging drainage ditches, breaking drain tile, and building dikes. Grassland restorations occur through planting former croplands with native grasses and giving technical assistance to landowners. Restored wetlands are typically placed under a 10-year conservation agreement. Grasslands are conserved under a 15-year agreement. On average, 500 acres of wildlife habitat is restored on private land in the District each year.

In addition to numerous successful habitat restorations, this program has fostered excellent relationships between the Service and many local partners including the Minnesota DNR, Natural Resource Conservation Service, soil and water conservation districts, conservation clubs and organizations, and most importantly, private landowners.